Service Manual

Fuller Heavy Duty Transmissions TRSM0446

January 2010

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SUPPORT

Warnings and Precautions

Before starting a vehicle always be seated in the driver's seat, place the transmission in neutral, set the parking brakes and disengage the clutch.

Before working on a vehicle place the transmission in neutral, set the parking brakes and block the wheels.

Before towing the vehicle place the transmission in neutral, and lift the rear wheels off the ground, remove the axle shafts, or disconnect the driveline to avoid damage to the transmission during towing.

The description and specifications contained in this service publication are current at the time of printing.

Eaton Corporation reserves the right to discontinue or modify its models and/or procedures and to change specifications at any time without notice.

Any reference to brand name in this publication is made as an example of the types of tools and materials recommended for use and should not be considered an endorsement. Equivalents may be used.

This symbol is used throughout this manual to call attention to procedures where carelessness or failure to follow specific instructions may result in personal injury and/or component damage.

Departure from the instructions, choice of tools, materials and recommended parts mentioned in this publication may jeopardize the personal safety of the service technican or vehicle operator.

Warning: Failure to follow indicated procedures creates a high risk of personal injury to the service technician.

Caution: Failure to follow indicated procedures may cause component damage or malfunction.

Note: Additional service information not covered in the service procedures.

Tip: Helpful removal and installation procedures to aid in the service of this unit.

Always use genuine Eaton replacement parts.

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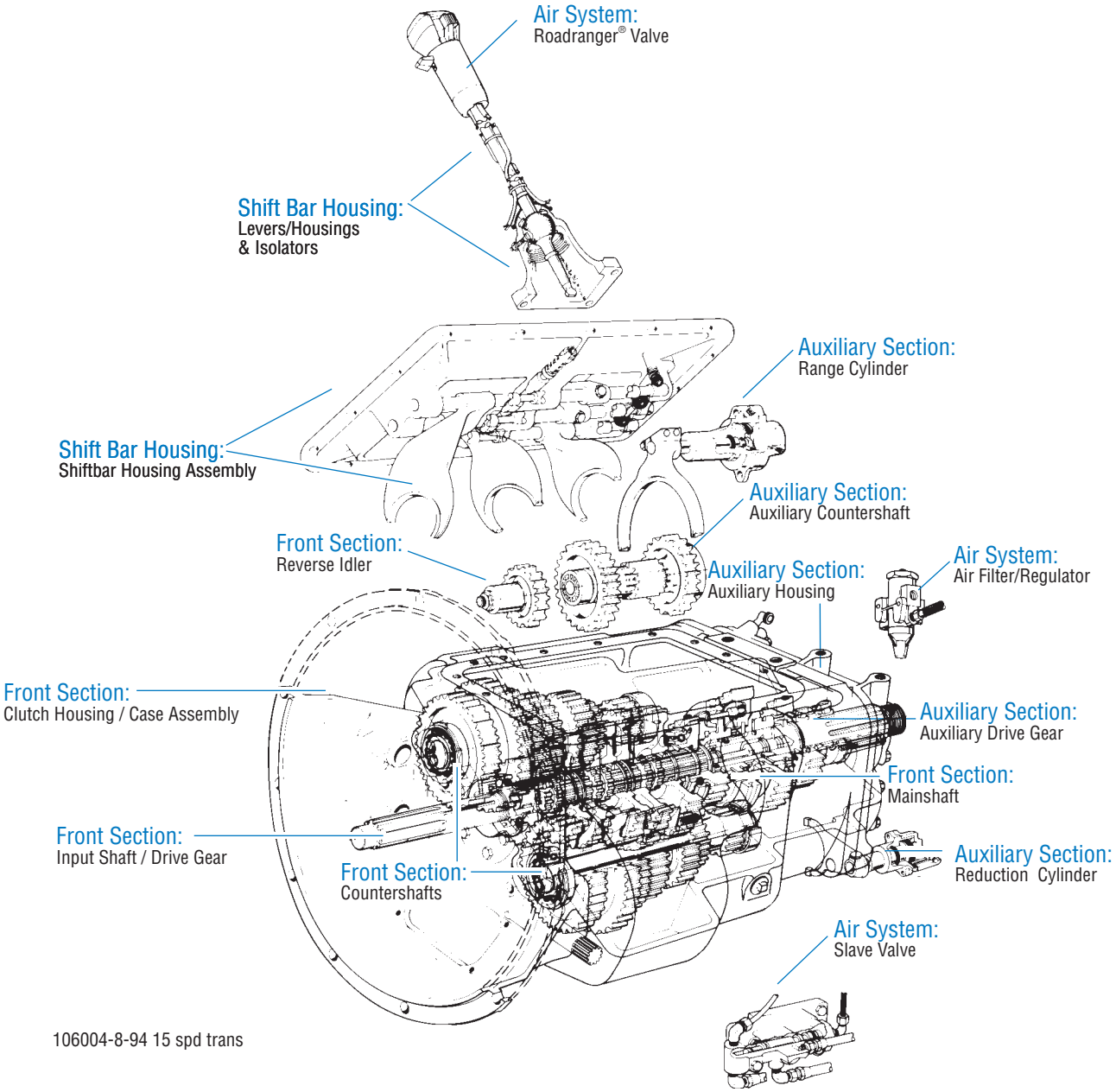
Transmission Overview



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Introduction

Purpose and Scope of Manual

This manual is designed to provide information necessary to service and repair the Fuller® transmissions listed on the front.

How to use this Manual

The service procedures have been divided into two sections: In-Vehicle Service Procedures and Transmission Overhaul Procedures—Bench Service. In-Vehicle Service Procedures contain procedures that can be performed while the transmission is still installed in the vehicle. Transmission Overhaul Procedures contain procedures that are performed after the transmission has been removed from the vehicle.

The procedure sections are laid out with a general heading at the top outside edge of each page followed by more specific headings and the procedures. To find the information you need in these sections, first go to the section that contains the procedure you need. Then look at the heading at the top and outside edge of each page until you find the one that contains the procedure you need.

Transmission Overhaul Procedures follow the general steps for complete disassembly and then assembly of the transmission.

Note: In some instances the transmission appearance may be different from the illustrations, but the procedure is the same.

Disassemble Precautions

It is assumed in the detailed assembly instructions that the lubricant has been drained from the transmission, the necessary linkage and vehicle air lines disconnected and the transmission has been removed from vehicle chassis. Removal of the gear shift lever housing assembly (or remote control assembly) is included in the detailed instructions (How to Remove the Gear Shift Lever). This assembly MUST be detached from the shift bar housing before the transmission can be removed.

Follow closely each procedure in the detailed instructions, make use of the text, illustrations, and photographs provided.

Assemblies

- When disassembling the various assemblies, such as the mainshaft, countershafts, and shift bar housing, lay all parts on a clean bench in the same sequence as removed. This procedure will simplify assembly and reduce the possibility of losing parts.

Bearings

- Carefully wash and lubricate all usable bearings as removed and protectively wrap until ready for use. Remove bearings planned to be reused with pullers designed for this purpose.

Cleanliness

- Provide a clean place to work. It is important that no dirt or foreign material enters the unit during repairs. Dirt is an abrasive and can damage bearings. It is always a good practice to clean the outside of the unit before starting the planned disassembly.

Input Shaft

- The input shaft can be removed from the transmission without removing the countershafts, mainshaft, or main drive gear. Special procedures are required and provided in this manual.

Snap Rings

- Remove snap rings with pliers designed for this purpose. Snap rings removed in this manner can be reused, if they are not sprung or loose.

When Using Tools to Move Parts

- Always apply force to shafts, housings, etc., with restraint. Movement of some parts is restricted. Never apply force to driven parts after they stop solidly. The use of soft hammers, soft bars, and mauls for all disassembly work is recommended.

Inspection Precautions

Before assembling the transmission, check each part carefully for abnormal or excessive wear and damage to determine reuse or replacement. When replacement is necessary, use only genuine Fuller® Transmission parts to assure continued performance and extended life from your unit.

Since the cost of a new part is generally a small fraction of the total cost of downtime and labor, avoid reusing a questionable part which could lead to additional repairs and expense soon after assembly. To aid in determining the reuse or replacement of any transmission part, consideration should also be given to the unit's history, mileage, application, etc.

Recommended inspection procedures are provided in the following checklist.

Bearings

- Wash all bearings in clean solvent. Check balls, rollers, and raceways for pitting, discoloration, and spalled areas. Replace bearings that are pitted, discolored, spalled, or damaged during disassembly.
- Lubricate bearings that are not pitted, discolored, or spalled and check for axial and radial clearances.
- Replace bearings with excessive clearances.
- Check bearing fit. Bearing inner races should be tight to shaft; outer races slightly tight to slightly loose in case bore. If the bearing spins freely in the bore the case should be replaced.

Bearing Covers

- Check covers for wear from thrust of adjacent bearing. Replace covers damaged from thrust of bearing outer race.
- Check cover bores for wear. Replace those worn or oversized.

Clutch Release Parts

- Check clutch release parts. Replace yokes worn at cam surfaces and bearing carrier worn at contact pads.
- Check pedal shafts. Replace those worn at bushing surfaces.

Gears

- Check gear teeth for frosting and pitting. Frosting of gear teeth faces presents no threat of transmission failure. Often in continued operation of the unit, frosted gears "heal" and do not progress to the pitting stage. In most cases, gears with light to moderate pitted teeth have considerable gear life remaining and can be reused, but gears in the advanced stage of pitting should be replaced.
- Check for gears with clutching teeth abnormally worn, tapered, or reduced in length from clashing during shifting. Replace gears found in any of these conditions.
- Check axial clearance of gears.

Gear Shift Lever Housing Assembly

- Check spring tension on shift lever. Replace tension spring if lever moves too freely.
- If housing is disassembled, check gear shift lever bottom end and shift finger assembly for wear. Replace both gears if excessively worn.

Gray Iron Parts

- Check all gray iron parts for cracks and breaks. Replace parts found to be damaged.

Oil Return Threads and Seals

- Check oil return threads on the input shaft. If return action of threads has been destroyed, replace the input shaft.
- Check oil seal in rear bearing cover. If sealing action of lip has been destroyed, replace seal.

O-Rings

- Check all o-rings for cracks or distortion. Replace if worn.

Reverse Idler Gear Assemblies

- Check for excessive wear from action of roller bearings.

Shift Bar Housing Assembly

- Check for wear on shift yokes and block at pads and lever slot. Replace excessively worn parts.
- Check yokes for correct alignment. Replace sprung yokes.
- Check lockscrew in yoke and blocks. Tighten and rewire those found loose.
- If housing has been disassembled, check neutral notches of shift bars for wear from interlock balls.

Sliding Clutches

- Check all shift yokes and yoke slots in sliding clutches for extreme wear or discoloration from heat.
- Check engaging teeth of sliding clutches for partial engagement pattern.

Splines

- Check splines on all shafts for abnormal wear. If sliding clutch gears, companion flange, or clutch hub has wear marks in the spline sides, replace the specific shaft effected.

Synchronizer Assembly

- Check synchronizer for burrs, uneven and excessive wear at contact surface, and metal particles.
- Check blocker pins for excessive wear or looseness.
- Check synchronizer contact surfaces on the synchronizer cups for wear.

Washers

- Check surfaces of all washers. Washers scored or reduced in thickness should be replaced.

Assembly Precautions

Make sure that case interiors and housings are clean. It is important that dirt and other foreign materials are kept out of the transmission during assembly. Dirt is an abrasive and can damage polished surfaces of bearings and washers. Use certain precautions, as listed below, during assembly.

Axial Clearances

- Maintain original axial clearances of 0.006-0.015 in. for mainshaft gears.

Bearings

- Use a flange-end bearing driver for bearing installation. These special drivers apply equal force to both bearing races, preventing damage to balls/rollers and races while maintaining correct bearing alignment with bore and shaft. Avoid using a tubular or sleeve-type driver, whenever possible, as force is applied to only one of the bearing races.

Capscrews

- To prevent oil leakage and loosening, use Fuller® sealant #71205 on all capscrews.

Gaskets

- Use new gaskets throughout the transmission as it is being rebuilt. Make sure all gaskets are installed. An omission of any gasket can result in oil leakage or misalignment of bearing covers.

Initial Lubrication

- Coat all limit washers and shaft splines with Lubricant during assembly to prevent scoring and galling of such parts.

O-Rings

- Lubricate all o-rings with silicon lubricant.

Universal Joint Companion Flange or Yoke

- Pull the companion flange or yoke tightly into place with the output shaft nut, using 450-500 lb-ft (610.12-677.91 N•m) of torque. Make sure the speedometer drive gear or a replacement spacer of the same width has been installed. Failure to pull the companion flange or yoke tightly into place can result in damage to the mainshaft rear bearing.

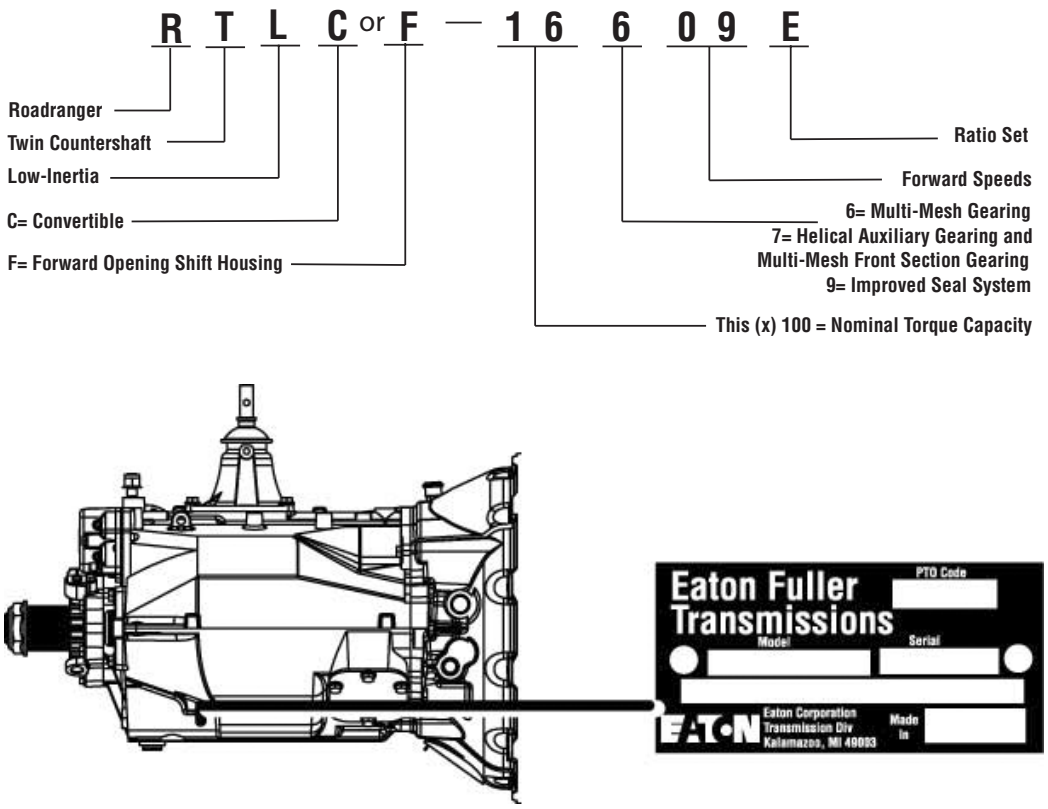
⚠ IMPORTANT

See the appropriate Illustrated Parts Lists (specified by model series) to ensure that proper parts are used during assembly of the transmission.

Serial Tag Information and Model Nomenclature

Transmission model designation and other transmission identification information are stamped on the transmission tag. To identify the transmission model designation and serial number, locate the tag on the transmission and then locate the numbers as shown.

When calling for service assistance or parts, have the model and serial numbers handy.



Do not remove or destroy the transmission identification tag.

The model number gives basic information about the transmission. Use this number when calling for service assistance or replacement parts.

Serial Number
The serial number is the sequential identification number of the transmission. Before calling for service assistance, write the number down. It may be needed.

Bill of Material or Customer Number
This number may be located below the model and serial numbers. It is a reference number used by Eaton®.

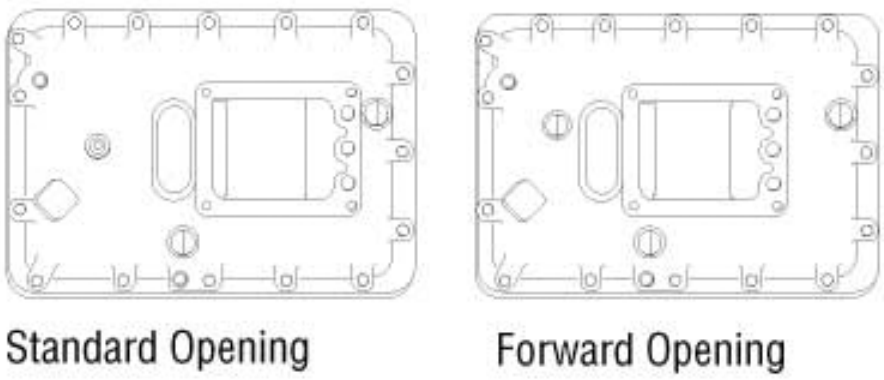
Model Options

Torque Rating
The torque rating of the transmission specified in the model number is the input torque capacity inLb•ft. Various torque ratings are available. For more information, call your Eaton Fuller regional sales and service office at 1-800-826-HELP (4357).

Shift Bar Housings
Two types of shift bar housings are available for this transmission. Both are described and shown below.

Standard
The standard shift bar housing has a gear shift lever opening that is located toward the rear of the transmission.

Forward
The forward shift bar housing has a gear shift lever opening located three inches closer to the transmission front than the standard opening. This forward design allows greater flexibility in mounting the transmission and is indicated by an "F" in the model number
.



Power Take Off (PTO) Usage
PTOs can be mounted in the following way:

6 or 8 Bolt: The 6 or 8 bolt openings are standard with the transmission. The PTO is mounted to the opening and driven from the PTO gear on the front countershaft.

Thru-Shaft: The thru-shaft PTO mounts on the rear of the transmission. It requires a special auxiliary housing and main case countershaft with internal splines.

Lubrication Pumps

Internal: An internal lubrication pump is located in the lower front of the transmission and is driven off the upper countershaft. Transmissions rated

PTO Driven: A PTO driven pump is externally mounted on the 6 or 8 bolt PTO openings and driven off the PTO gear.

Lubrication Specifications

IMPORTANT

Transmission filters should be changed during regular lube intervals. Inspection of the transmission filter should be conducted during preventive maintenance checks for damage or corrosion. Replace as necessary.

Note: For a list of Eaton® Approved Synthetic Lubricants, see TCMT0021 or call 1-800-826-HELP (4357).

Note: The use of lubricants not meeting these requirements will affect warranty coverage.

Note: Additives and friction modifiers must not be introduced. Never mix engine oils and gear oils in the same transmission.

Buy from a reputable dealer

For a complete list of approved and reputable dealers, write to: Eaton Corporation, Worldwide Marketing Services, P.O. Box 4013, Kalamazoo, MI 49003,

Transmission Operating Angles

If the transmission operating angle is more than 12 degrees, improper lubrication will occur. The operating angle is the transmission mounting angle in the chassis plus the percent of upgrade (expressed in degrees). For operating angles over 12 degrees, the transmission must be equipped with an oil pump or cooler kit to insure proper lubrication.

Operating Temperatures with Oil Coolers

The transmission must not be operated consistently at temperatures above 250°F. Operation at temperatures above 250°F [121°C] causes loaded gear tooth temperatures to exceed 350°F [177°C] which will ultimately destroy the heat treatment of the gears. If the elevated temperature is associated with an unusual operating condition that will reoccur, a cooler should be added, or the capacity of the existing cooling system increased.
The following conditions in any combination can cause operating temperatures of over 250° F [121°C]:

- Operating consistently at slow speed.
- High ambient temperatures.
- Restricted air flow around transmission.
- Use of engine retarder.
- High horsepower operation.

Note: Transmission coolers must be used to reduce the operating temperatures when the above conditions are encountered.

Oil Cooler Chart

Table 4

TRANSMISSION OIL COOLERS ARE:
Recommended
• With engines of 350 H.P. and above.
Required
• With engines 399 H.P. and above and GCW's over 90,000 lbs.
• With engines 399 H.P. and above and 1400 lb-ft (1898.15 N•m) or greater torque.
• With engines 1500 lb-ft (2033.73 N•m) and above
18-speed AutoShift transmissions require use of an Eaton® supplied oil-to-water cooler or approved equivalent.
• With engines 450 H.P. and above.

Tool Specifications

Some repair procedures pictured in this manual show the use of specialized tools. Their actual use is recommended as they make transmission repair easier, faster, and prevent costly damage to critical parts.

For the most part, ordinary mechanic's tools such as socket wrenches, screwdrivers, etc., and other standard shop items such as a press, mauls and soft bars are the only tools needed to successfully disassemble and reassemble any Fuller® transmission.

The following tables list and describe the typical tools required to properly service this model transmission above and beyond the necessary basic wrenches, sockets, screwdrivers, and prybars.

General Tools

The following tools are available from several tool manufacturers such as Snap-On, Mac, Craftsman, OTC, and many others.

Table 5 General Tools

TOOL	PURPOSE
0-100 lb-ft 1/2" drive Torque Wrench	General torquing of fasteners (Typically 15-80 lb-ft [20.34-108.47 N•m])
0-600 lb-ft 3/4" or 1" drive Torque Wrench	Torquing of output nut to 500 lb-ft (677.91 N•m)
0-50 lb-in 3/8" drive Torque Wrench	General torquing of fasteners
0-30 lb-in 1/4" drive Torque Wrench	Torquing of capscrews to 7 lb-in (0.79 N•m) during auxiliary countershaft bearing endplay setting procedure
70 MM or 2 2/4" Socket - Standard Depth	To remove the output yoke nut
Large Brass Drift	Used to protect shafts and bearings during removal
Large Dead Blow Hammer or Maul	To provide force for shaft and bearing removal
Snap Ring Pliers - Large Standard External	To remove the snap rings at the auxiliary drive gear, input shaft bearing, and countershaft bearings
Feeler Gauges	To set mainshaft washer endplay and auxiliary tapered bearing endplay
Rolling Head (Crow's Foot) Prybar	To remove the auxiliary drive gear bearing
(2) Air Pressure Gauges 0-100 PSI (0-1034 kPa)	To troubleshoot and verify correct operation of air system
Universal Bushing Driver	To remove and install clutch housing bushings. Bushing OD = 1.125 in., ID = 1.000 in.

Recommended Tools

The following special tools are designed for this Fuller® transmission. The addresses and phone numbers of the tool suppliers are listed after the table. This list is provided as a convenience to our customers. These tools are manufactured by independent companies with no relationship to Eaton. Eaton does not warrant the fit or function of the listed tools. To obtain the tools, contact the tool supplier directly.

Table 6 Special Tools

REFERENCE NUMBER	TOOL	PURPOSE	G & W TOOL NO.	GREAT LAKES TOOL NO.	OTC TOOL NO.
T1	Output Yoke Puller	May be required to remove a rusted output yoke.	SP-450		7075
T2	Auxiliary Section Hanger	To support, or hang, the auxiliary section in the horizontal position.	G-40	T-125	5061
T3	Auxiliary Countershaft Support and Shim Tool	To hold the auxiliary countershafts in position while installing the auxiliary section in the horizontal position. Also to simplify the checking and setting of the auxiliary countershaft bearing endplay.	G-250	T-311	5062
T4	Shift Lever Spring Installation Tool (Tension Spring Driver)	To install the shift tower tension spring.	G-116	T-170	
T5	Slide Hammer	To remove the output seal and reverse idler shafts. Requires 1/2"-13 threads. (Optional, idler shaft can be driven out from front.)	G-70	T-150	1155 Slide Hammer / 8007 1/2" -13 Adapter
T6	Bearing Puller	To remove front section countershaft bearings.	G-10 or G-15	T-1 and T-2 for 9-Series	7070A Kit
T7	Bearing Driver	To install front section countershaft bearings (3.97" OD, 1.78" ID).	G200 Kit	T-101 Kit	
T8	Bearing Driver	To install the front countershaft rear bearings (3.5" OD, 1.6" ID).	G200 Kit	T-101 Kit	
T9	Countershaft Support Tools (2)	To support and locate the front section countershafts during bearing removal and installation.	G-50 / G-51 / G-58	T-145S	7109
T10	Input Bearing Driver	To install input bearing on input shaft.	G-35	T-120	5066 (2" shaft)
T11	Bearing Puller	To remove the auxiliary countershaft tapered bearings.	4332/4232		1123 / 927

Table 6 Special Tools (Continued)

REFERENCE NUMBER	TOOL	PURPOSE	G & W TOOL NO.	GREAT LAKES TOOL NO.	OTC TOOL NO.
T12	Bearing Driver	To install the auxiliary countershaft tapered bearings.	G-200 Kit	T-105 Kit	
T13	Output Seal Removal Tool	To remove the output seal in chassis. Can use slide hammer.			Use 27315 hook with 1155 slide hammer
T14	Auxiliary Section Removal Adapter Plate	To attach transmission jack to auxiliary section for auxiliary section removal in chassis.	G-115		49611 (Used with OTC transmission jack P/N 5019.)
T15	Mainshaft Hook	To assist in lifting of mainshaft from front section.	G-225	T-165	
T16	Input Bearing Puller	To remove input bearing.	G-38	T-3	7070A Kit
T17	Bearing Race Puller	To remove the auxiliary countershaft tapered bearing outer races.			7136 puller attached to 1155 slide hammer
T18	Bearing Race Installer	To install the auxiliary countershaft tapered bearing outer races.			27524/27530 discs used with 27488 handle and 10020 screw.
* Tool ID numbers are referenced in the service procedures. Special Tools					

Table 7 Shop Equipment

20 Ton capacity press	To press countershaft gears from countershaft.

Specialty Tool Manufacturers
Below are the addresses and phone numbers of the companies that make tools specifically for Eaton®Fuller® transmissions:

G and W Tool Company
1105 E. Louisville, Broken Arrow, OK 74012-5724, Phone: 800-247-5882, or 918-258-6881

Great Lakes Tool
8530 M-89, Richland, MI 49083, Phone: 800-877-9618, or 269-629-9628

O.T.C. 655 Eisenhower Dr., Owatonna, MN 55060-117, Phone: 800-533-6127, or 507-455-7000

The specialized tools can be obtained from a tool supplier or made from tool prints as required by the individual user. Detailed Fuller® Transmission Tool Prints are available upon request by writing to:

Eaton Corporation, **Truck Components Operations** Technical Service, P.O. Box 4013, Kalamazoo, Michigan 49003

Recommended Tools

Eaton Aftermarket Parts

The following tools are available through Eaton Aftermarket Parts. To obtain any of the tools listed, contact your local Eaton parts distributor.

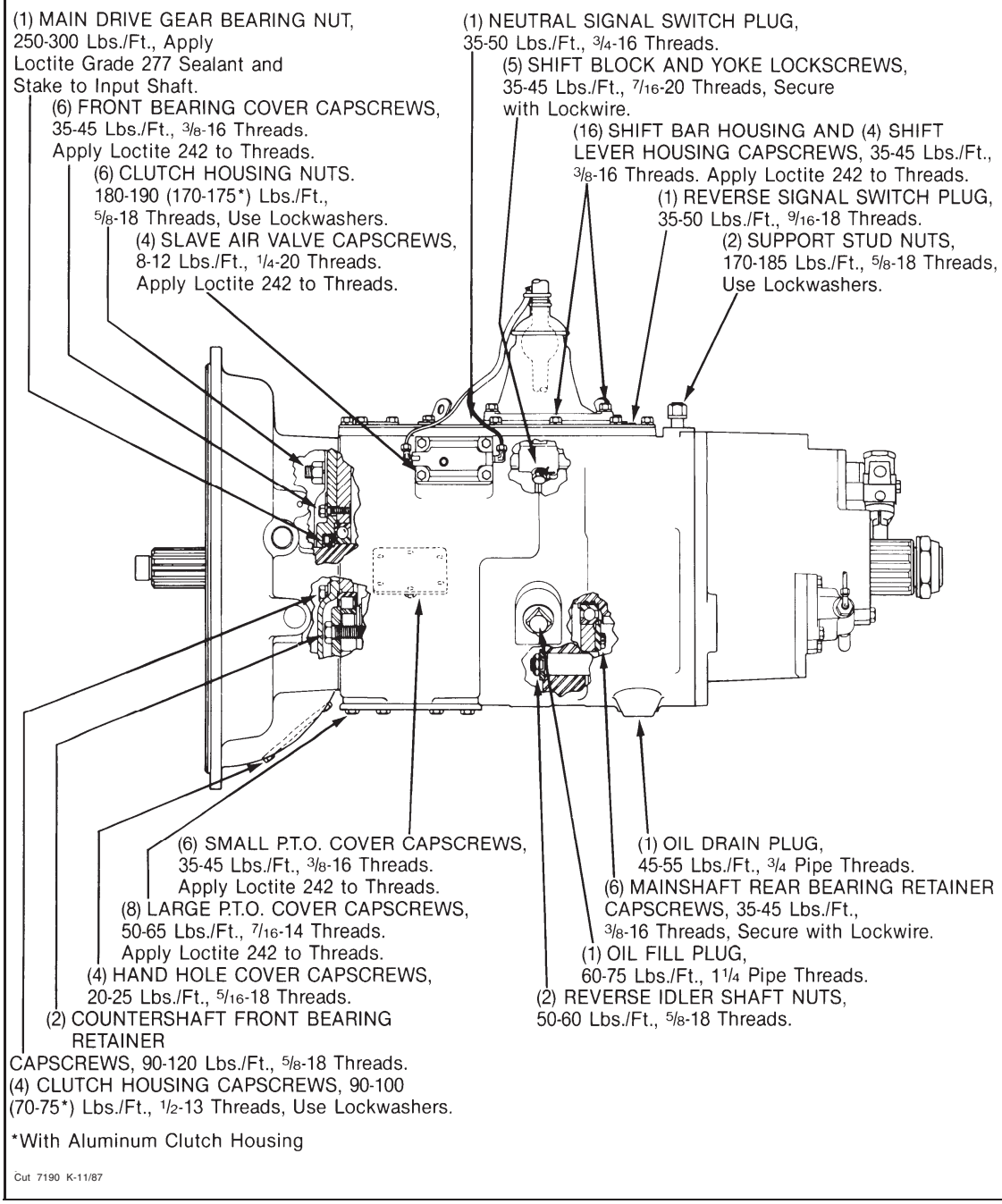
Table 8

TOOL	PURPOSE	EATON® PART NUMBER
5/32” Air Line Release Tool	To remove 5/32” air lines from push-to-connect fittings.	P/N 4301157 included in kit K-2394
Air Line Cutting Tool	To cut plastic air lines smoothly and squarely.	P/N 4301158 included in kit K-2394.
Output Seal Driver	To install output seal.	For 7 series: Eaton P/N 5564501 driver. For 9 series: Use Eaton® P/N 5564509 adapter with 5564501 driver. Both parts included in complete Eaton® seal kit P/N TCMT0912.
Output Seal Slinger Driver	To install output seal slinger.	For 7 series: Eaton P/N 71223. For 9 series: Eaton P/N 4303829.

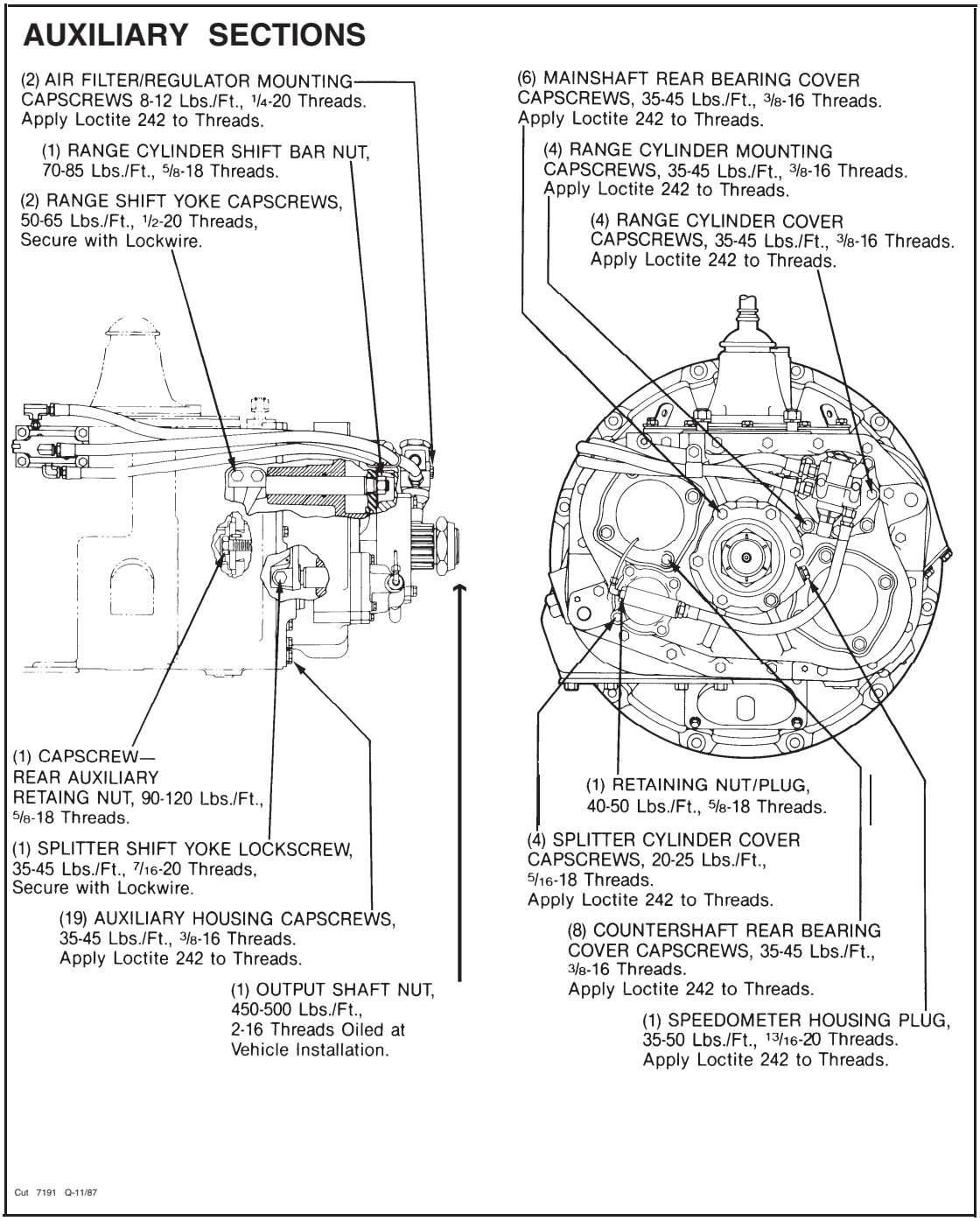
Transmission Torque Specifications

Correct torque application is extremely important to assure long transmission life and dependable performance. Over-tightening or under-tightening can result in a loose installation and in many instances, eventually cause damage to transmission gears, shafts, and/or bearings. Use a torque wrench whenever possible to attain recommended Lbs•ft. ratings. Do not torque capscrews dry.

FRONT SECTION: ALL MODELS


(1) MAIN DRIVE GEAR BEARING NUT, 250-300 Lbs./Ft., Apply Loctite Grade 277 Sealant and Stake to Input Shaft.
(6) FRONT BEARING COVER CAPSCREWS, 35-45 Lbs./Ft., 3/8-16 Threads. Apply Loctite 242 to Threads.
(6) CLUTCH HOUSING NUTS. 180-190 (170-175*) Lbs./Ft., 5/8-18 Threads, Use Lockwashers.
(4) SLAVE AIR VALVE CAPSCREWS, 8-12 Lbs./Ft., 1/4-20 Threads. Apply Loctite 242 to Threads.
(1) NEUTRAL SIGNAL SWITCH PLUG, 35-50 Lbs./Ft., 3/4-16 Threads.
(5) SHIFT BLOCK AND YOKE LOCKSCREWS, 35-45 Lbs./Ft., 7/16-20 Threads, Secure with Lockwire.
(16) SHIFT BAR HOUSING AND (4) SHIFT LEVER HOUSING CAPSCREWS, 35-45 Lbs./Ft., 3/8-16 Threads. Apply Loctite 242 to Threads.
(1) REVERSE SIGNAL SWITCH PLUG, 35-50 Lbs./Ft., 9/16-18 Threads.
(2) SUPPORT STUD NUTS, 170-185 Lbs./Ft., 5/8-18 Threads, Use Lockwashers.
(6) SMALL P.T.O. COVER CAPSCREWS, 35-45 Lbs./Ft., 3/8-16 Threads. Apply Loctite 242 to Threads.
(8) LARGE P.T.O. COVER CAPSCREWS, 50-65 Lbs./Ft., 7/16-14 Threads. Apply Loctite 242 to Threads.
(4) HAND HOLE COVER CAPSCREWS, 20-25 Lbs./Ft., 5/16-18 Threads.
(2) COUNTERSHAFT FRONT BEARING RETAINER CAPSCREWS, 90-120 Lbs./Ft., 5/8-18 Threads.
(4) CLUTCH HOUSING CAPSCREWS, 90-100 (70-75*) Lbs./Ft., 1/2-13 Threads, Use Lockwashers.
(1) OIL DRAIN PLUG, 45-55 Lbs./Ft., 3/4 Pipe Threads.
(6) MAINSHAFT REAR BEARING RETAINER CAPSCREWS, 35-45 Lbs./Ft., 3/8-16 Threads, Secure with Lockwire.
(1) OIL FILL PLUG, 60-75 Lbs./Ft., 1 1/4 Pipe Threads.
(2) REVERSE IDLER SHAFT NUTS, 50-60 Lbs./Ft., 5/8-18 Threads.
*With Aluminum Clutch Housing
Cut 7190 K-11/87

Auxiliary Sections

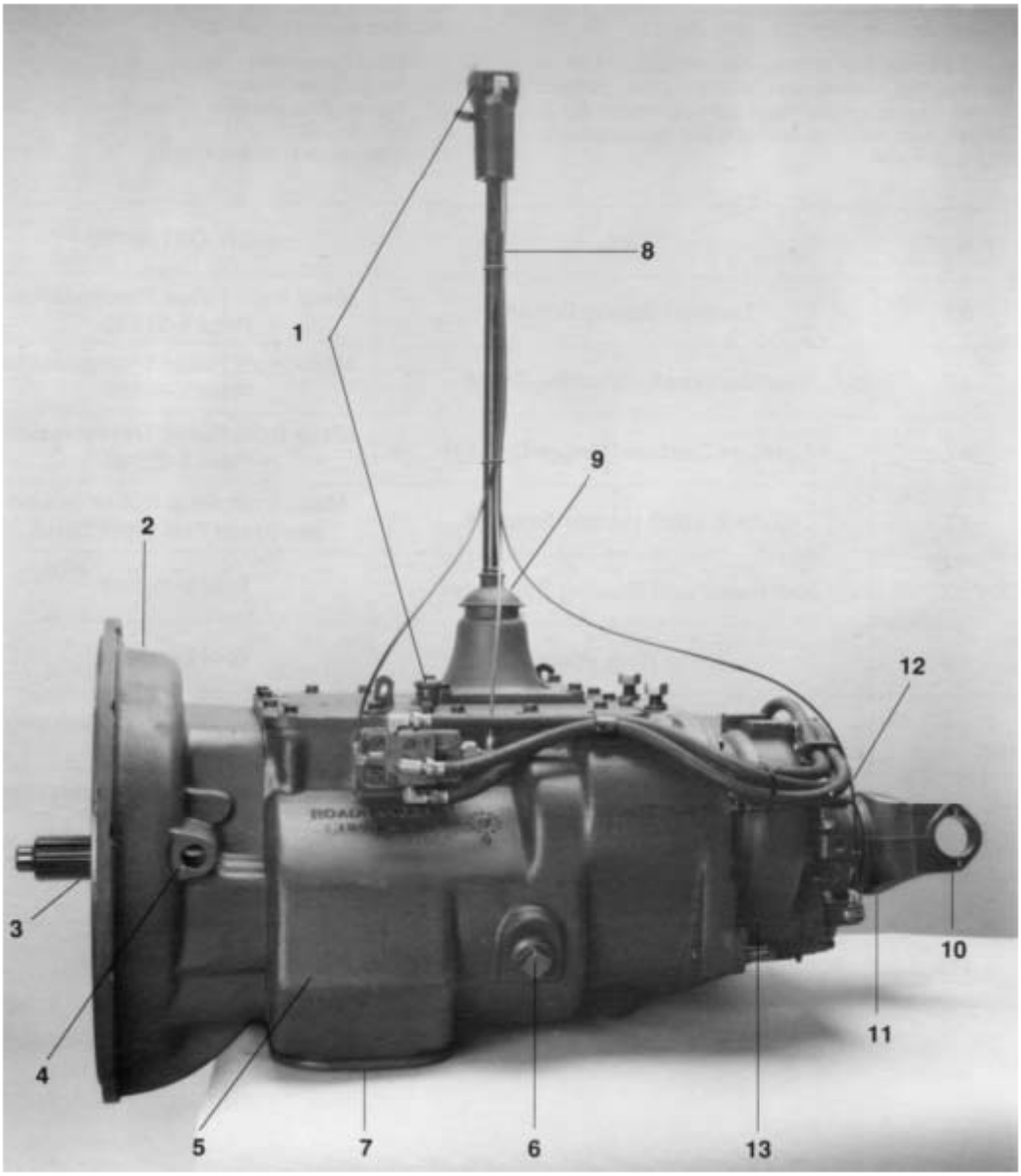

AUXILIARY SECTIONS
(2) AIR FILTER/REGULATOR MOUNTING CAPSCREWS 8-12 Lbs./Ft., 1/4-20 Threads. Apply Loctite 242 to Threads.
(1) RANGE CYLINDER SHIFT BAR NUT, 70-85 Lbs./Ft., 5/8-18 Threads.
(2) RANGE SHIFT YOKE CAPSCREWS, 50-65 Lbs./Ft., 1/2-20 Threads, Secure with Lockwire.
(1) CAPSCREW— REAR AUXILIARY RETAING NUT, 90-120 Lbs./Ft., 5/8-18 Threads.
(1) SPLITTER SHIFT YOKE LOCKSCREW, 35-45 Lbs./Ft., 7/16-20 Threads, Secure with Lockwire.
(19) AUXILIARY HOUSING CAPSCREWS, 35-45 Lbs./Ft., 3/8-16 Threads. Apply Loctite 242 to Threads.
(1) OUTPUT SHAFT NUT, 450-500 Lbs./Ft., 2-16 Threads Oiled at Vehicle Installation.
(6) MAINSHAFT REAR BEARING COVER CAPSCREWS, 35-45 Lbs./Ft., 3/8-16 Threads. Apply Loctite 242 to Threads.
(4) RANGE CYLINDER MOUNTING CAPSCREWS, 35-45 Lbs./Ft., 3/8-16 Threads. Apply Loctite 242 to Threads.
(4) RANGE CYLINDER COVER CAPSCREWS, 35-45 Lbs./Ft., 3/8-16 Threads. Apply Loctite 242 to Threads.
(1) RETAINING NUT/PLUG, 40-50 Lbs./Ft., 5/8-18 Threads.
(4) SPLITTER CYLINDER COVER CAPSCREWS, 20-25 Lbs./Ft., 5/16-18 Threads. Apply Loctite 242 to Threads.
(8) COUNTERSHAFT REAR BEARING COVER CAPSCREWS, 35-45 Lbs./Ft., 3/8-16 Threads. Apply Loctite 242 to Threads.
(1) SPEEDOMETER HOUSING PLUG, 35-50 Lbs./Ft., 13/16-20 Threads. Apply Loctite 242 to Threads.
Cut 7191 Q-11/87

Preventative Maintenance Check Points

Everyday there are countless vehicles operating over the highways with transmissions in such a neglected mechanical condition, they can be referred to as failures looking for a place to break down. They lack a proper and organized preventive maintenance program.

Preventive maintenance is a general term which applies to all procedures necessary to have maximum life and satisfactory service at the lowest possible cost, short of removing and repairing the unit.

A number of conditions contrary to good preventive maintenance can generally be pointed to when inspecting a failed transmission. Taking a few minutes every so many hours or miles to do a few simple checks could help avoid eventual breakdown or reduce the repair cost. If the transmission is not cared for, it will breakdown.



Note: Transmission appearance may differ, however the procedure is the same.

1. **Air System and Connections**
   - Check for leaks, worn air lines, loose connections and capscrews.
2. **Clutch Housing Mounting**
   - Check all capscrews of clutch housing flange for looseness.
3. **Clutch Release Bearing** (Not Shown)
   - Remove hand hole cover and check radial and axial clearance in release bearing.
   - Check relative position of thrust surface of release bearing with thrust sleeve on push-type clutches.
4. **Clutch Pedal Shaft and Bores**
   - Pry upward on shafts to check wear.
   - If excessive movement is found, remove clutch release mechanism and check bushings on bores and wear on shafts. See OEM literature.
5. **Lubricant**
   - Change at specified service intervals.
   - Use only the types and grades as recommended. See “Recommended Lubrication Chart” (see Table 2).
6. **Filler and Drain Plugs**
   - Remove filler plugs and check level of lubricant at specified intervals. Tighten fill and drain plugs securely.
7. **Capscrews and Gaskets**
   - For applicable models, check all capscrews, especially those on PTO covers and rear bearing covers for looseness which would cause oil leakage.
   - Check PTO opening and rear bearing covers for oil leakage due to faulty gasket.
8. **Gear Shift Lever**
   - Check for looseness and free play in housing. If lever is loose in housing, proceed with Check No. 9.
9. **Gear Shift Lever Housing Assembly**
   - If present, remove air lines at air valve or slave valve. Remove the gear shift lever housing assembly from the transmission.
   - Check the tension spring and washer for set and wear.
   - Check the gear shift lever spade pin and slot for wear.
   - Check bottom end of gear shift lever for wear and check slot of yokes and blocks in shift bar housing for wear at contact points with shift lever.

Checks With Drive Line Dropped

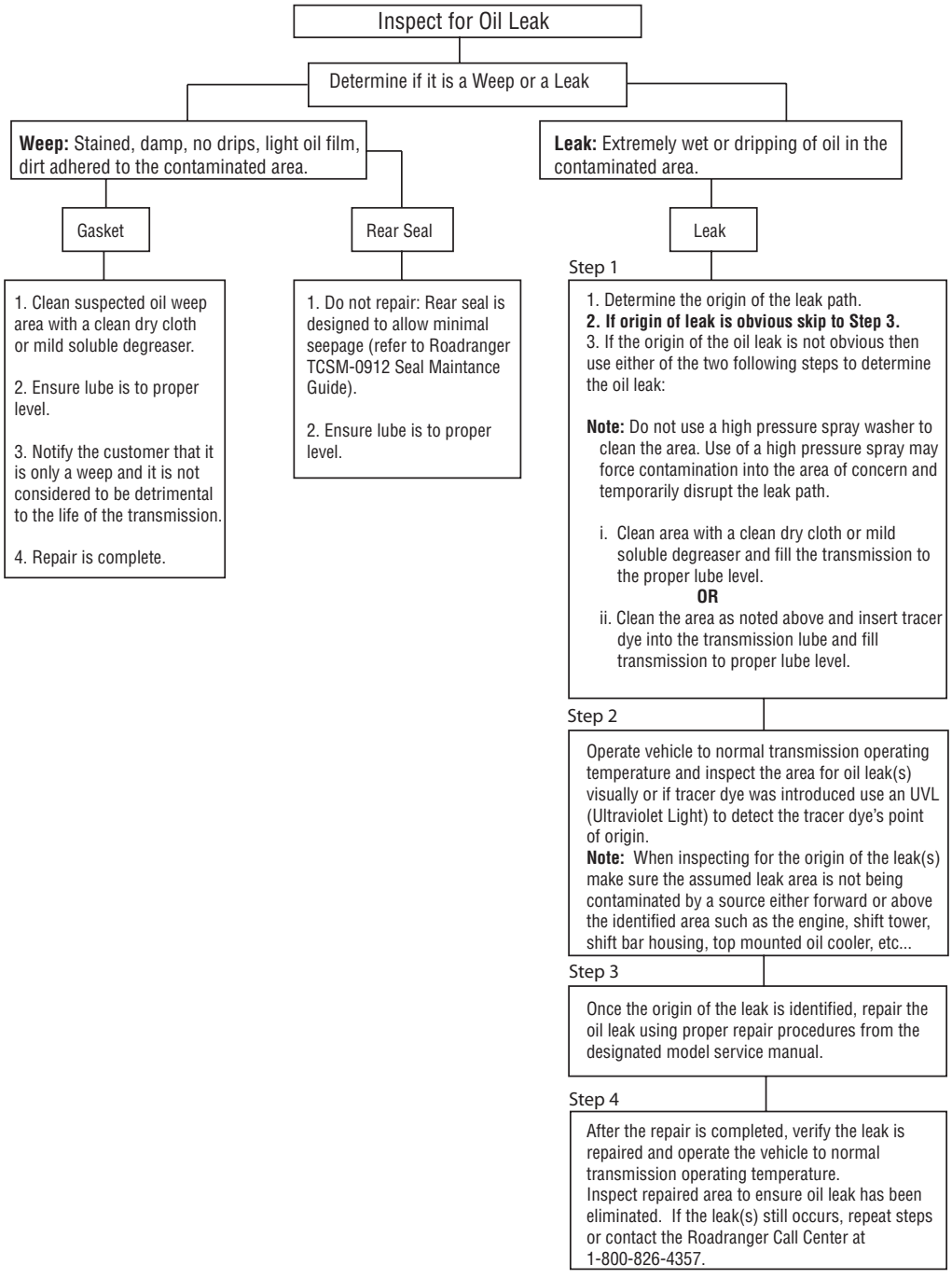
10. **Universal Joint Companion Flange or Yoke Nut**
    - Check for tightness. Tighten to recommended torque.
11. **Output Shaft** (Not Shown)
    - Pry upward against output shaft to check radial clearance in mainshaft rear bearing.

Checks With Universal Joint Companion Flange or Yoke Removed

Note: If necessary, use solvent and shop rag to clean sealing surface of companion flange or yoke. Do not use crocus cloth, emery paper, or other abrasive materials that will mar surface finish.

12. **Splines on Output Shaft** (Not Shown)
    - Check for wear from movement and chucking action of the universal joint companion flange or yoke.
13. **Mainshaft Rear Bearing Cover** (Not Shown)
    - Check oil seal for wear.

Oil Leak Inspection Process

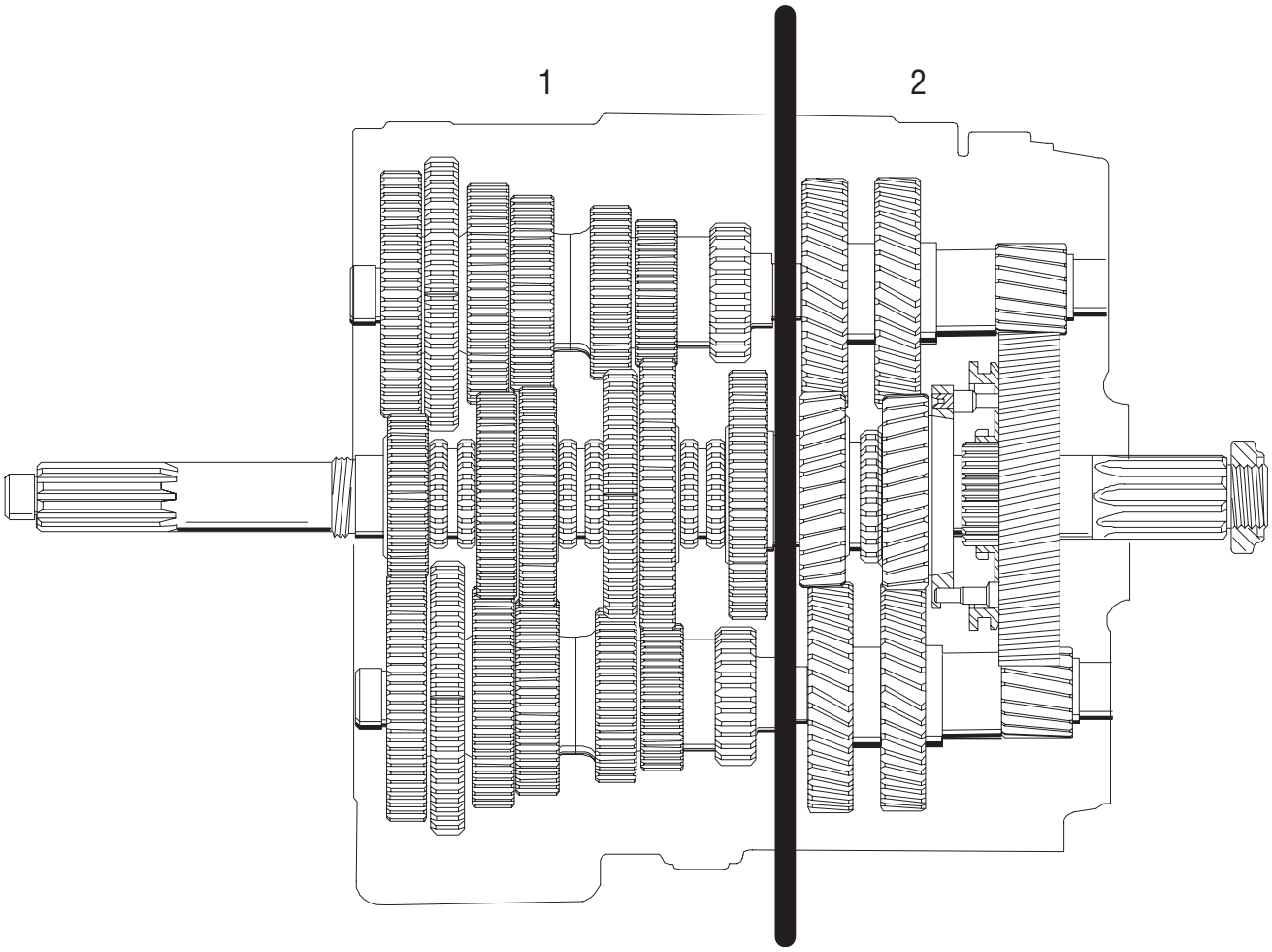

Inspect for Oil Leak
Determine if it is a Weep or a Leak
Weep: Stained, damp, no drips, light oil film, dirt adhered to the contaminated area.
Leak: Extremely wet or dripping of oil in the contaminated area.
Gasket
Rear Seal
Leak
1. Clean suspected oil weep area with a clean dry cloth or mild soluble degreaser.
2. Ensure lube is to proper level.
3. Notify the customer that it is only a weep and it is not considered to be detrimental to the life of the transmission.
4. Repair is complete.
1. Do not repair: Rear seal is designed to allow minimal seepage (refer to Roadranger TCSM-0912 Seal Maintance Guide).
2. Ensure lube is to proper level.
Step 1
1. Determine the origin of the leak path.
2. If origin of leak is obvious skip to Step 3.
3. If the origin of the oil leak is not obvious then use either of the two following steps to determine the oil leak:
Note: Do not use a high pressure spray washer to clean the area. Use of a high pressure spray may force contamination into the area of concern and temporarily disrupt the leak path.
i. Clean area with a clean dry cloth or mild soluble degreaser and fill the transmission to the proper lube level.
OR
ii. Clean the area as noted above and insert tracer dye into the transmission lube and fill transmission to proper lube level.
Step 2
Operate vehicle to normal transmission operating temperature and inspect the area for oil leak(s) visually or if tracer dye was introduced use an UVL (Ultraviolet Light) to detect the tracer dye's point of origin.
Note: When inspecting for the origin of the leak(s) make sure the assumed leak area is not being contaminated by a source either forward or above the identified area such as the engine, shift tower, shift bar housing, top mounted oil cooler, etc...
Step 3
Once the origin of the leak is identified, repair the oil leak using proper repair procedures from the designated model service manual.
Step 4
After the repair is completed, verify the leak is repaired and operate the vehicle to normal transmission operating temperature.
Inspect repaired area to ensure oil leak has been eliminated. If the leak(s) still occurs, repeat steps or contact the Roadranger Call Center at 1-800-826-4357.

Power Flow Diagrams

An understanding of the engine's power flow through a transmission in each particular gear will assist the technician in trouble-shooting and servicing a transmission.

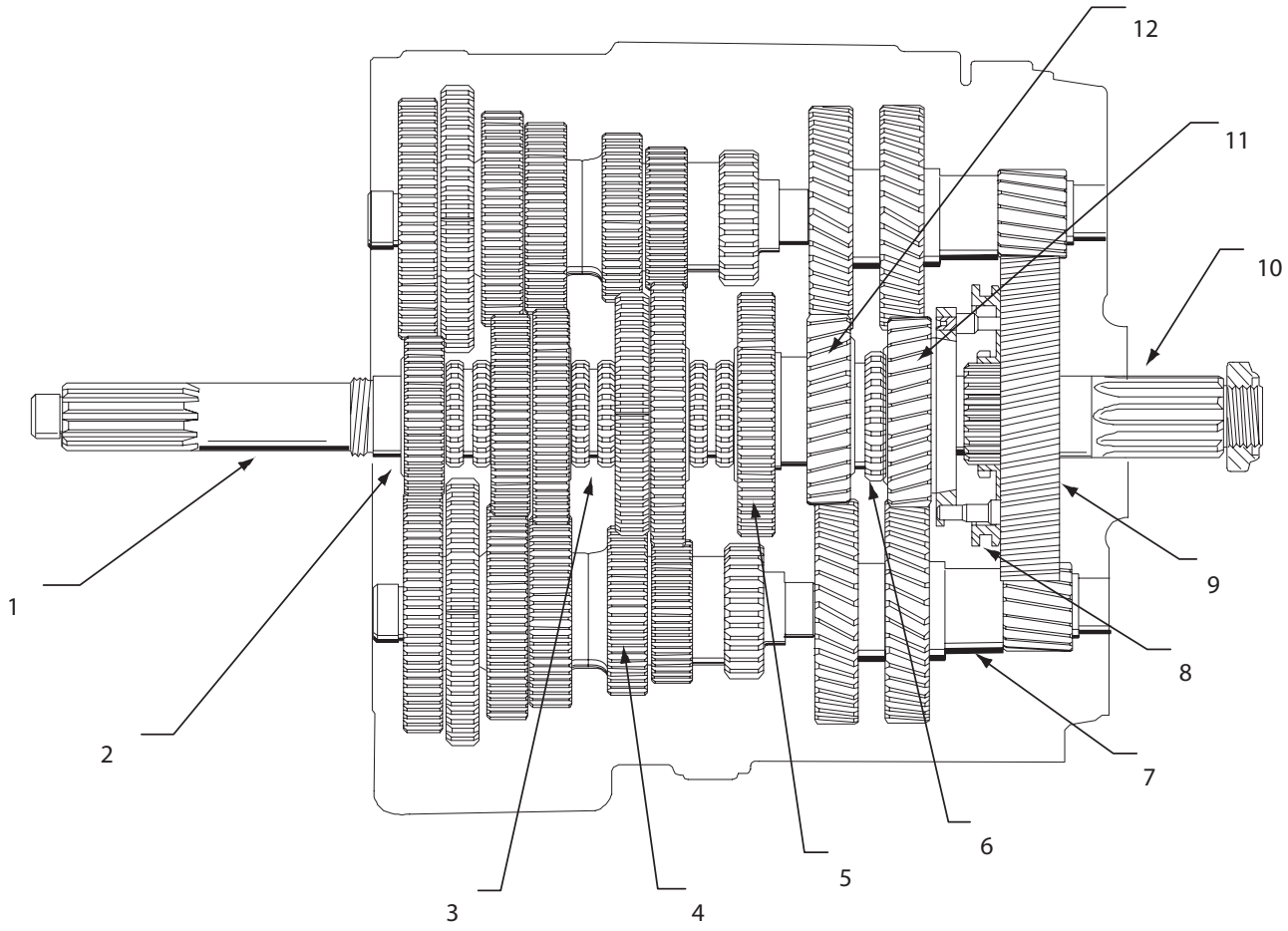
The Eaton®Fuller®Roadranger transmission can be thought of as two separate "transmissions" combined into one unit. The first "transmission" or front section contains six gear sets which are shifted with the gear shift lever. The second "transmission" called the auxiliary section, contains three gear sets and is shifted with air pressure.

Note: This transmission is referred to as a constant mesh type transmission. When in operation, all gears are turning even though only some of them are transferring power.



Cross Sectional View
1. Front Section
2. Front Section

The transmission components in the figure below shows the transmission with the main components called out. Note that the transmission is in the neutral position because the sliding clutches are all in their center positions and not engaged in any gears.

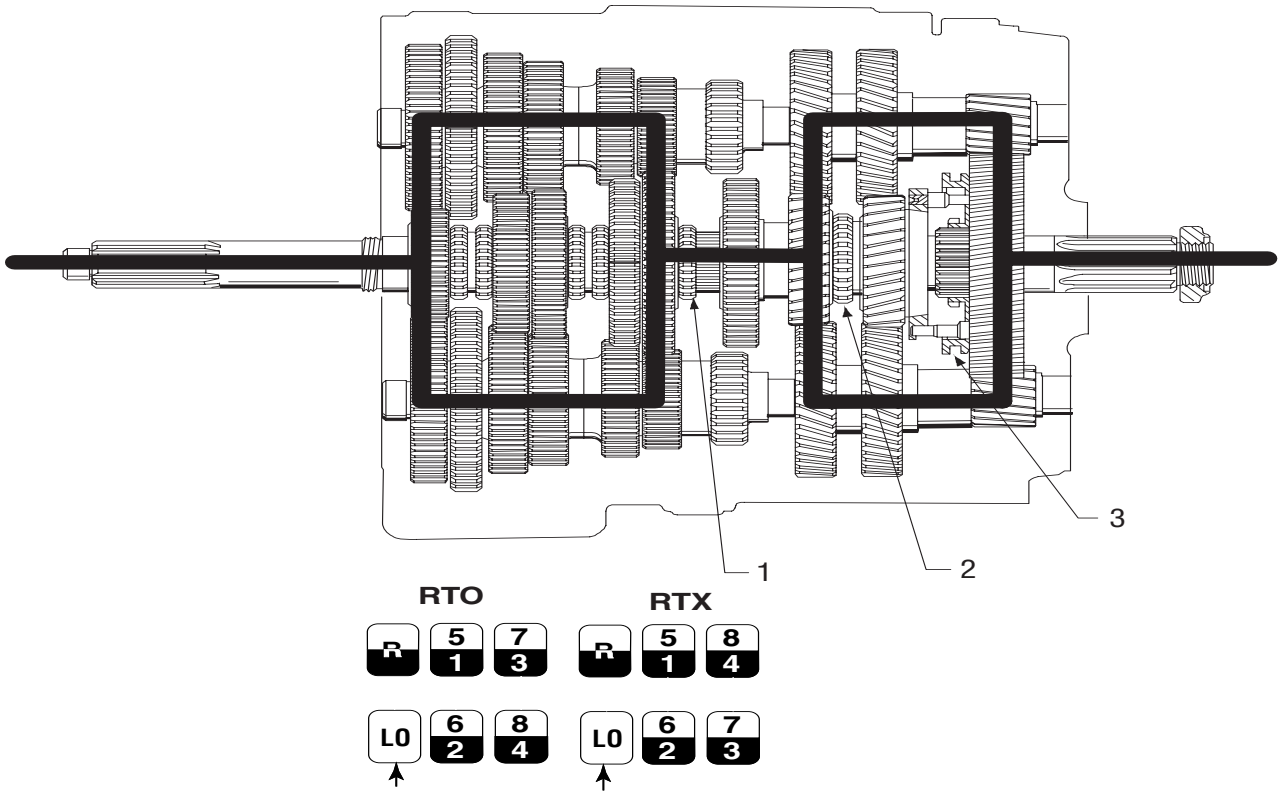


Transmission Components
1. Input Shaft
2. Main Drive Gear
3. Sliding Clutch
4. Countershaft
5. Mainshaft Gear
6. Auxiliary Splitter Clutch (slides on front section mainshaft)
7. Auxiliary Countershaft
8. Range Sliding Clutch
9. Auxiliary Mainshaft Reduction Gear
10. Output Shaft (Auxiliary Mainshaft)
11. Splitter Gear
12. Auxiliary Drive Gear

Front Section Power Flow

Note: The heavy lines in the figure below outline the power flow description. For help in understanding the transmission components, refer to the figure “Transmission Components” on the previous page.

1. Power (torque) from the vehicle's engine is transferred to the transmission's input shaft.
2. The input shaft rotates the main drive gear through internal splines in the hub of the gear.
3. The main drive gear meshes with both countershaft driven gears and the torque is split between both countershafts.
4. Because the countershaft gears are in constant mesh with the mainshaft gears, all the front section gearing rotates. However, only the engaged or selected mainshaft gear will have torque. External clutching teeth on the sliding clutch will engage internal clutching teeth on the selected mainshaft gear. Torque will now be provided from both opposing countershaft gears, into the engaged mainshaft gear, and through the sliding clutch to the front section mainshaft.
5. The rear of the front section mainshaft is splined into the auxiliary splitter clutch and torque is now delivered to the auxiliary splitter clutch.

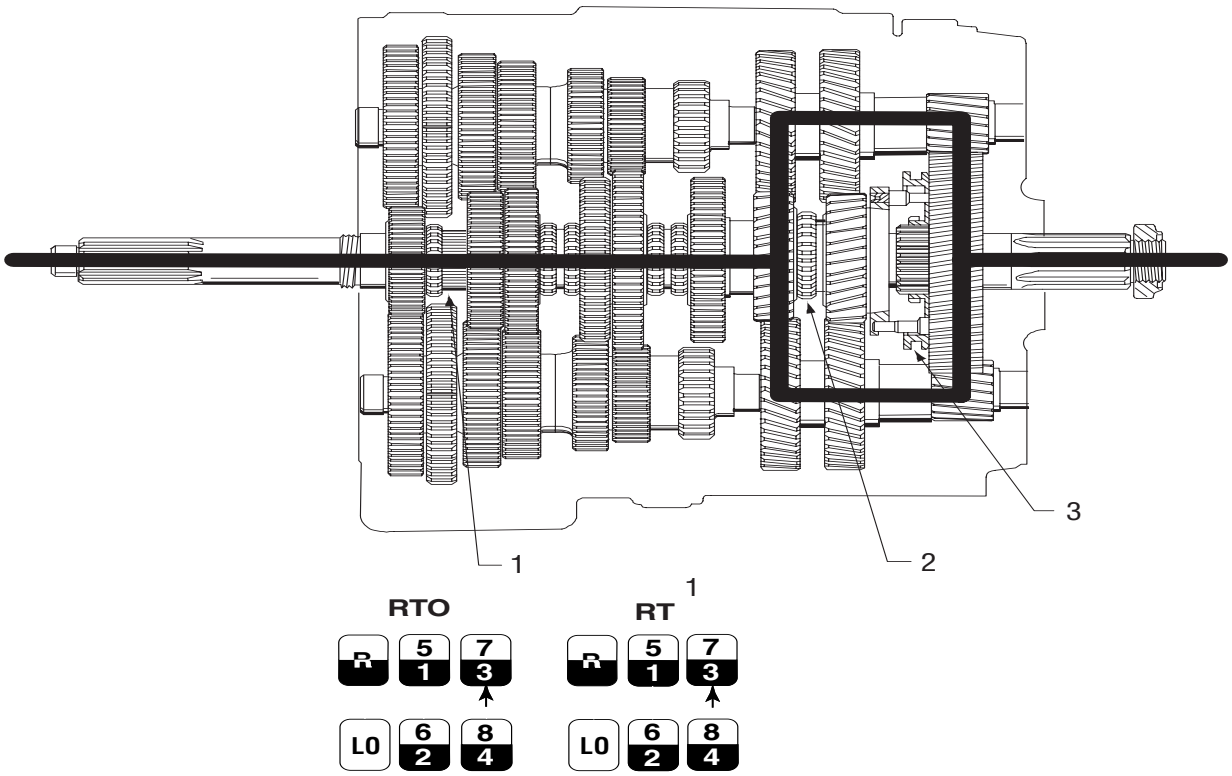


Front Section Power Flow
1. Sliding Clutch forward
2. Sliding Clutch forward
3. Sliding Clutch rearward

Front Section Power Flow - Direct Gear

In direct gear, the front sliding clutch is moved forward and engages into the back of the main drive gear. Torque will flow from the input shaft to the main drive gear, main drive gear to sliding clutch, sliding clutch straight into the front section mainshaft which delivers the torque to the auxiliary splitter clutch. See figure below.

Note: All countershaft and mainshaft gears will rotate, but the gears will not be loaded.

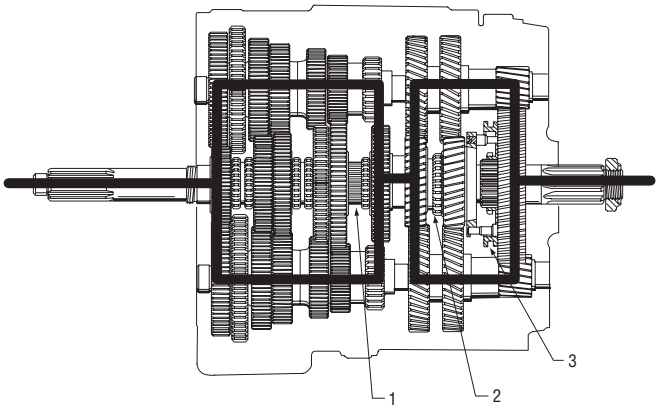


Front Section Power Flow - Direct Gear
1. Sliding Clutch forward
2. Sliding Clutch forward
3. Sliding Clutch rearward

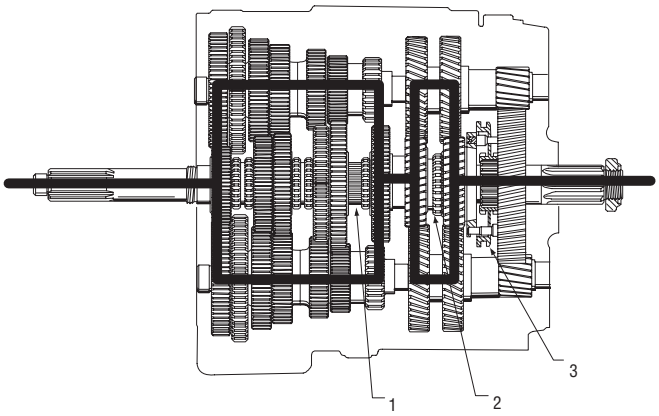
Front Section Power Flow - Reverse Gear

Torque will flow from the countershafts to the reverse idler gears. Torque will then flow from the reverse idler gears to the mainshaft reverse gear. Torque will now travel through the mainshaft reverse gear, the sliding clutch in the reverse position and then to the mainshaft and auxiliary splitter clutch. See figures below.

Note: The idler gears cause the reversal of rotation.



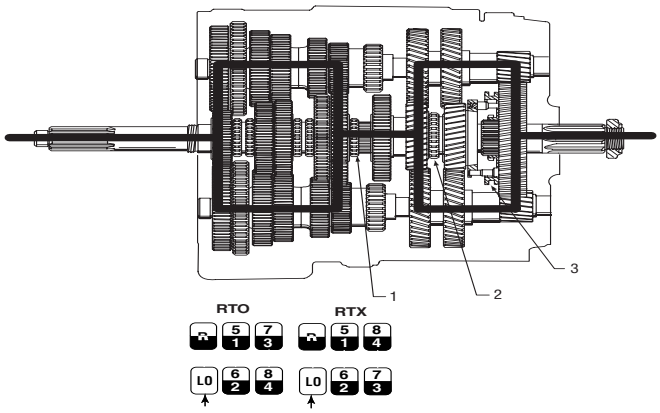
Reverse LO - 9/13 speed
1. Sliding Clutch rearward
2. Sliding Clutch forward
3. Sliding Clutch rearward



Reverse HI - 9/13 speed
1. Sliding Clutch rearward
2. Sliding Clutch forward
3. Sliding Clutch forward

Auxiliary Section Power Flow - Low Range

If the auxiliary section is in low range, the range sliding clutch is rearward and engaged into the auxiliary mainshaft reduction gear. Torque flows from the auxiliary countershafts, into the auxiliary mainshaft reduction gear, through the range sliding clutch and then into the output shaft (auxiliary mainshaft).



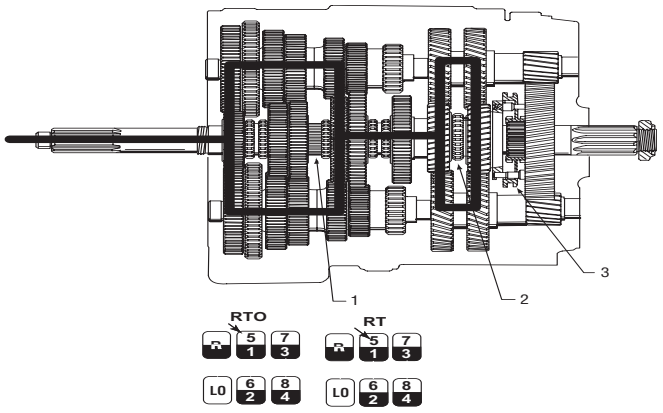
LO - 9/13 Speed

1. Sliding Clutch forward
2. Sliding Clutch forward
3. Sliding Clutch rearward

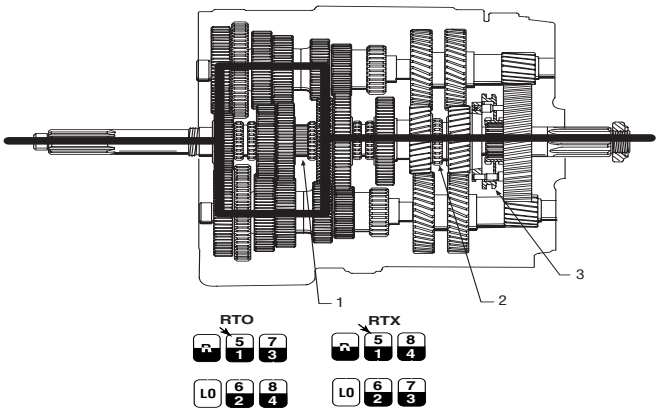
Auxiliary Section Power Flow - High Range

If the auxiliary section is in high range, the range sliding clutch is forward and engaged into the back of the auxiliary drive gear. Torque flows through the auxiliary section in high range depending on the splitter state selected (L or H). If splitter (L) is selected, torque flows from the auxiliary splitter clutch to the auxiliary drive gear. From the auxiliary drive gear, torque flows to both countershafts and then to the splitter gear. Torque then flows into the range sliding clutch and output shaft.

If splitter (H) is selected, torque flows directly through the auxiliary section. Torque flows from the auxiliary splitter clutch to the auxiliary reduction gear to the range sliding clutch to the output shaft. The auxiliary gearing still turns, but the gear teeth will not be loaded.

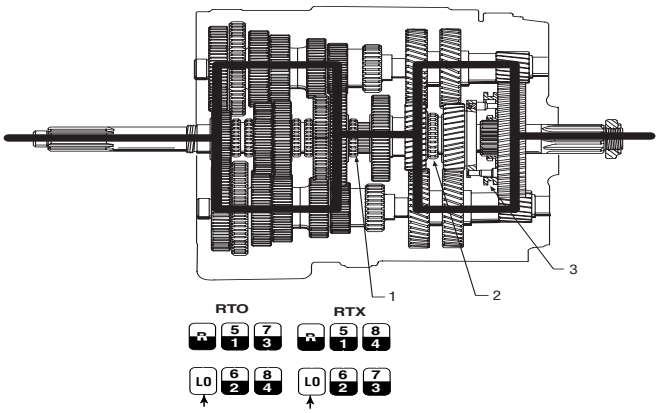


5th - 9/13 speed Split Low
1. Sliding Clutch rearward
2. Sliding Clutch forward
3. Sliding Clutch forward



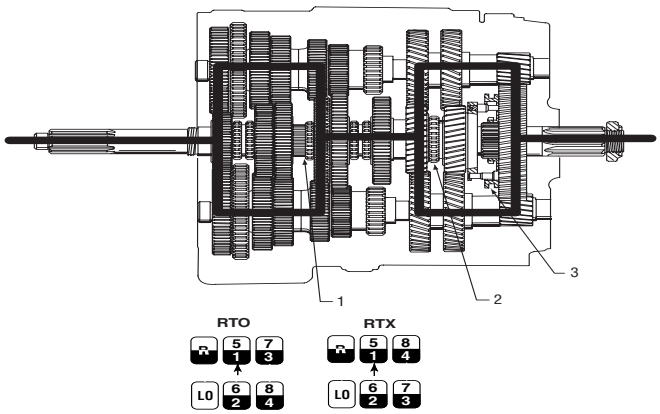
5th - 9/13 speed Split High
1. Sliding Clutch rearward
2. Sliding Clutch rearward
3. Sliding Clutch forward

9-Speed



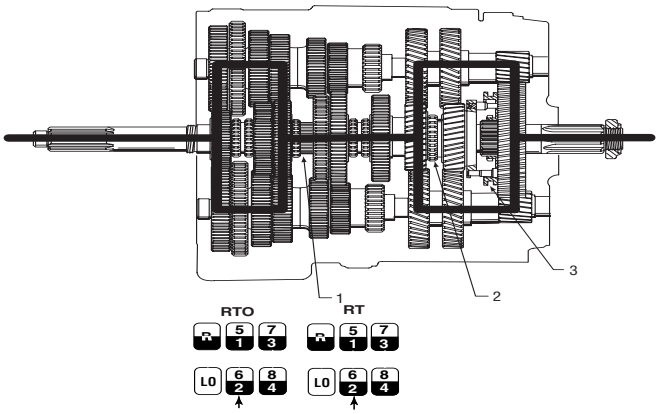
LO Gear

1. Sliding Clutch forward
2. Sliding Clutch rearward
3. Sliding Clutch rearward



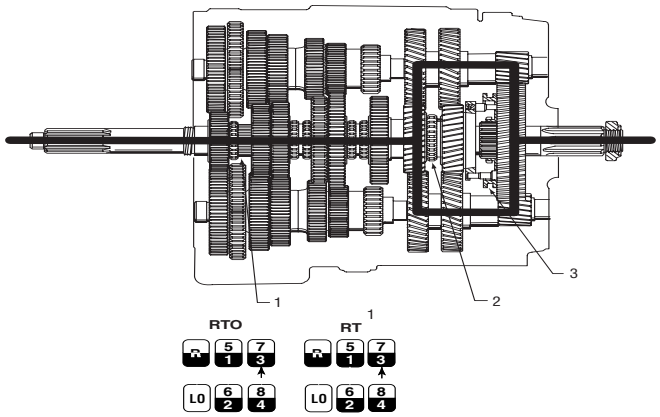
1st Gear

1. Sliding Clutch rearward
2. Sliding Clutch rearward
3. Sliding Clutch rearward



2nd Gear

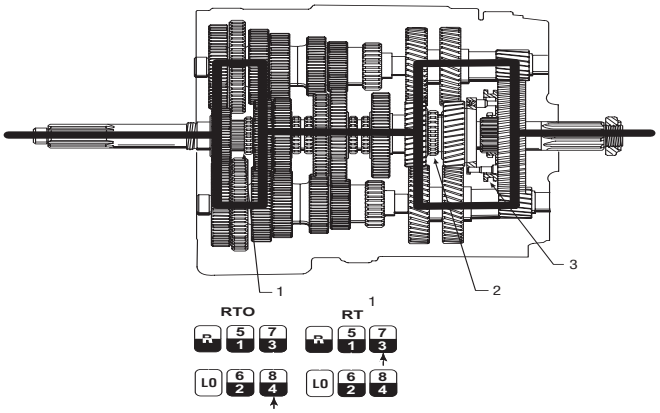
1. Sliding Clutch forward
2. Sliding Clutch rearward
3. Sliding Clutch rearward



3rd Gear

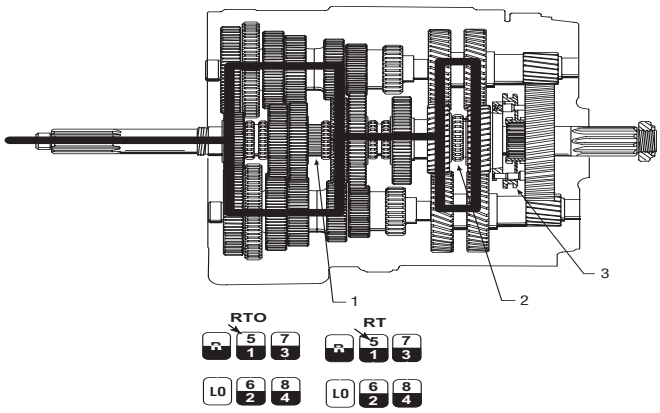
1. Sliding Clutch forward
2. Sliding Clutch rearward
3. Sliding Clutch rearward

Power Flow



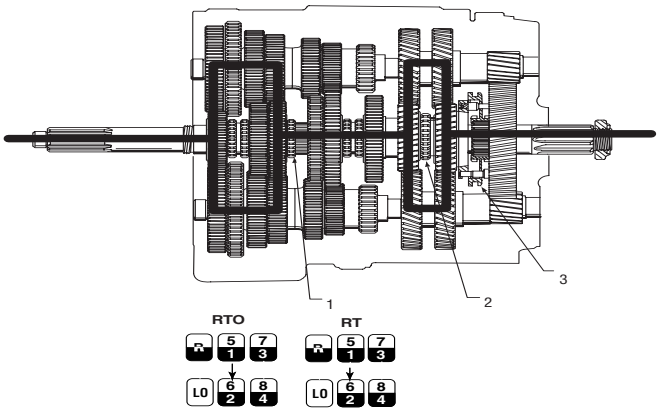
4th Gear

1. Sliding Clutch rearward
2. Sliding Clutch rearward
3. Sliding Clutch rearward



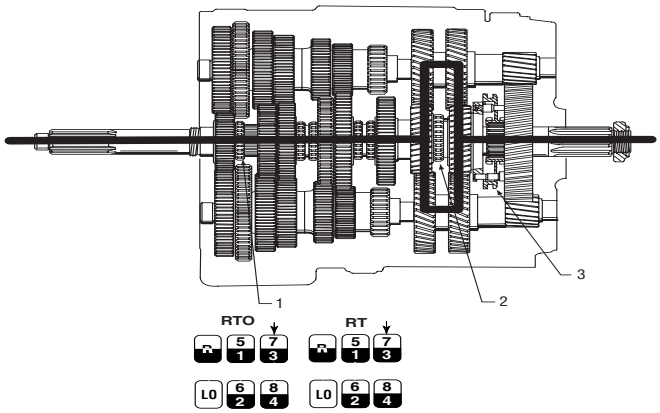
5th - Gear

1. Sliding Clutch rearward
2. Sliding Clutch rearward
3. Sliding Clutch forward



6th - Gear

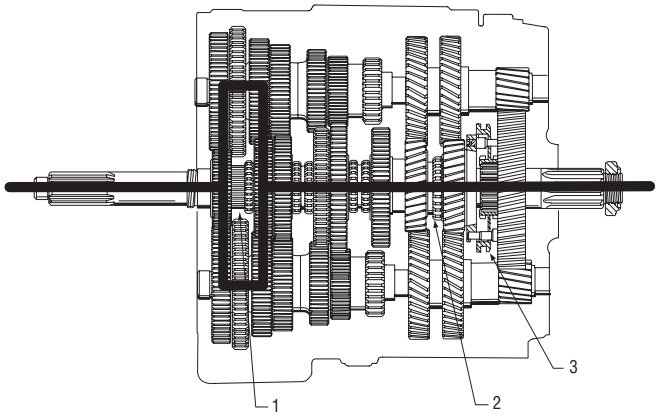
1. Sliding Clutch forward
2. Sliding Clutch rearward
3. Sliding Clutch forward



7th - Gear

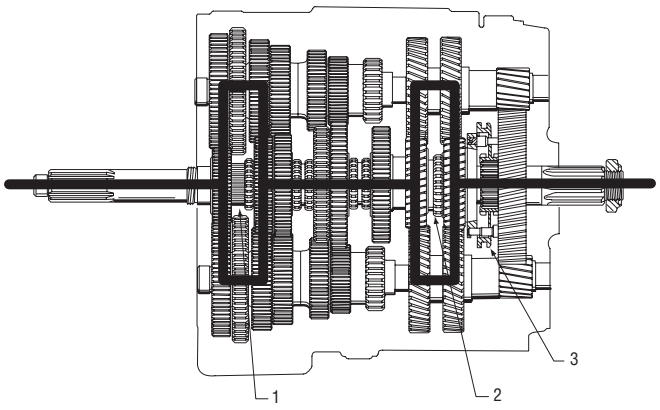
1. Sliding Clutch forward
2. Sliding Clutch rearward
3. Sliding Clutch forward

9 Speed - Non Top 2 Models

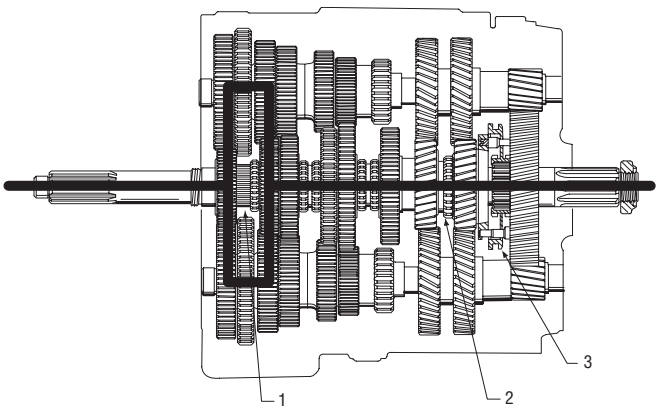


8th Gear
1. Sliding Clutch rearward
2. Sliding Clutch rearward
3. Sliding Clutch forward

9 Speed Top 2 Models

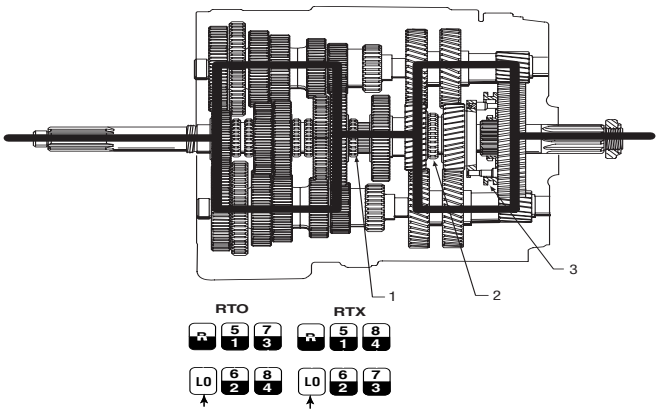


8th - Low Split Gear
1. Sliding Clutch rearward
2. Sliding Clutch forward
3. Sliding Clutch forward

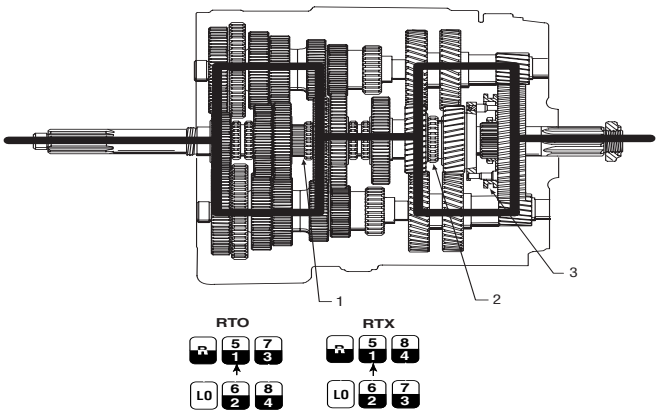


8th - High Split Gear
1. Sliding Clutch rearward
2. Sliding Clutch rearward
3. Sliding Clutch forward

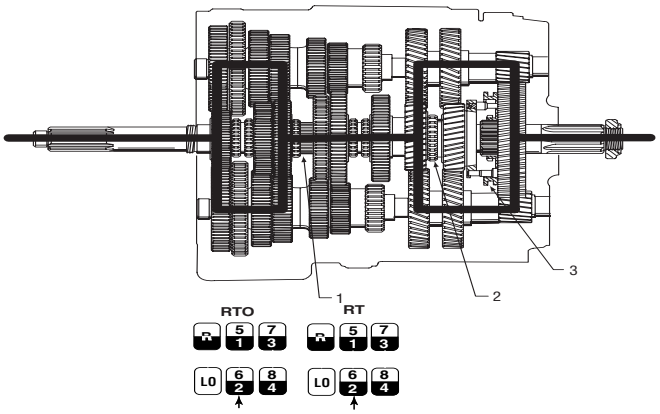
13 Speed — Power Flow by Gear



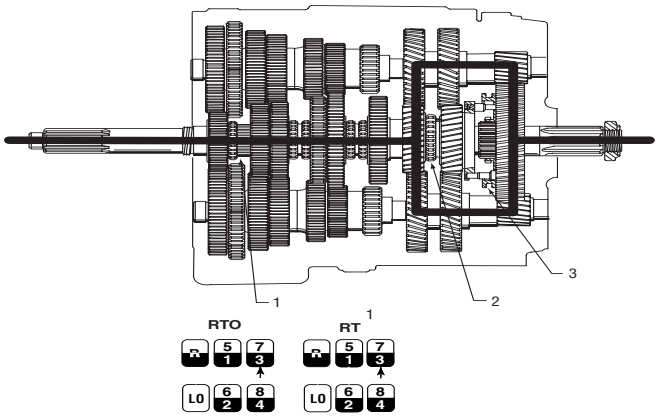
LO Gear
1. Sliding Clutch forward
2. Sliding Clutch forward
3. Sliding Clutch rearward



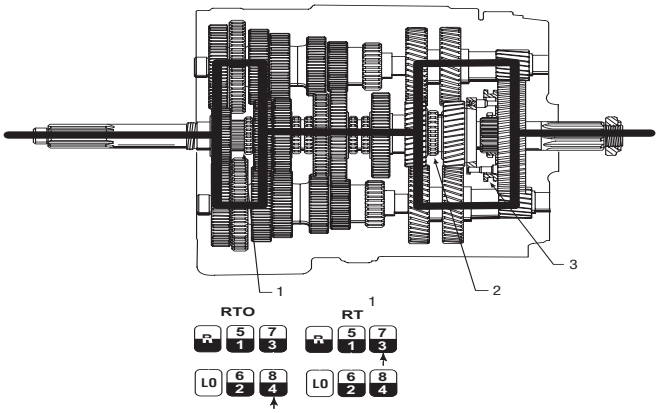
1st Gear
1. Sliding Clutch rearward
2. Sliding Clutch forward
3. Sliding Clutch rearward



2nd Gear
1. Sliding Clutch forward
2. Sliding Clutch forward
3. Sliding Clutch rearward

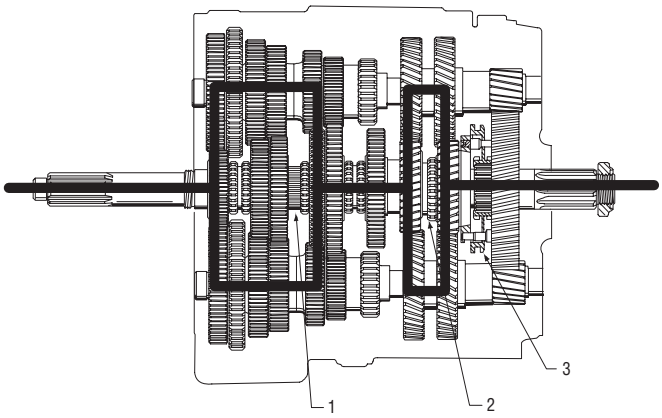


3rd Gear
1. Sliding Clutch forward
2. Sliding Clutch forward
3. Sliding Clutch rearward



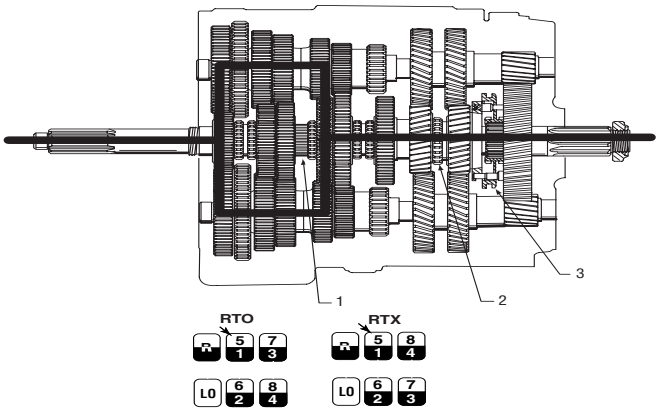
4th Gear

1. Sliding Clutch rearward
2. Sliding Clutch forward
3. Sliding Clutch rearward



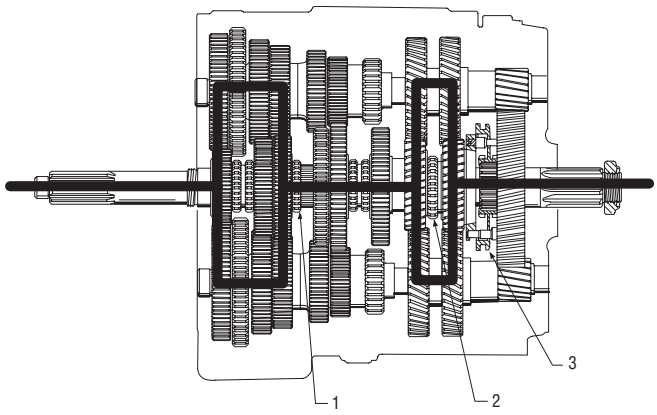
5th - Low Split Gear

1. Sliding Clutch rearward
2. Sliding Clutch forward
3. Sliding Clutch forward



5th - High Split Gear

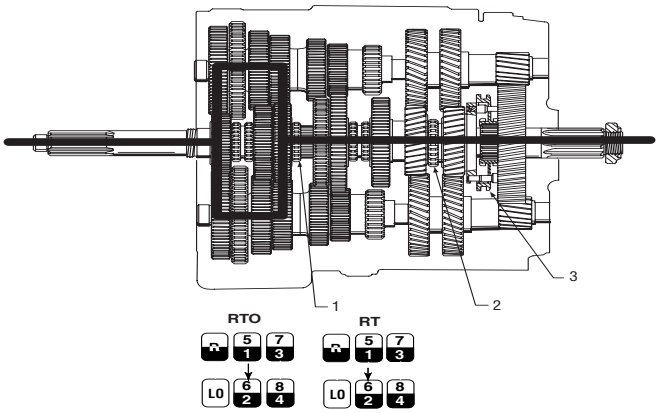
1. Sliding Clutch rearward
2. Sliding Clutch rearward
3. Sliding Clutch forward



6th - Low Split Gear

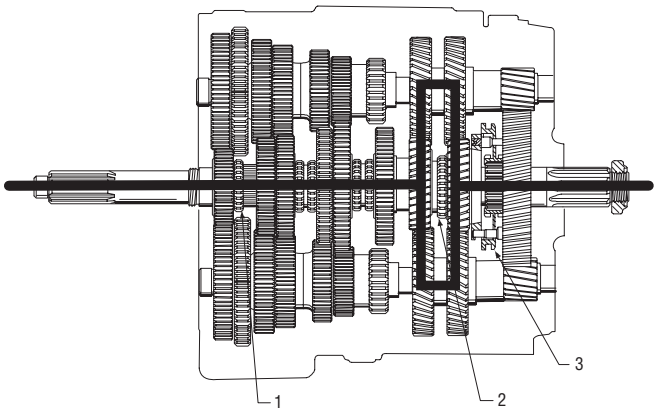
1. Sliding Clutch forward
2. Sliding Clutch forward
3. Sliding Clutch forward

Power Flow



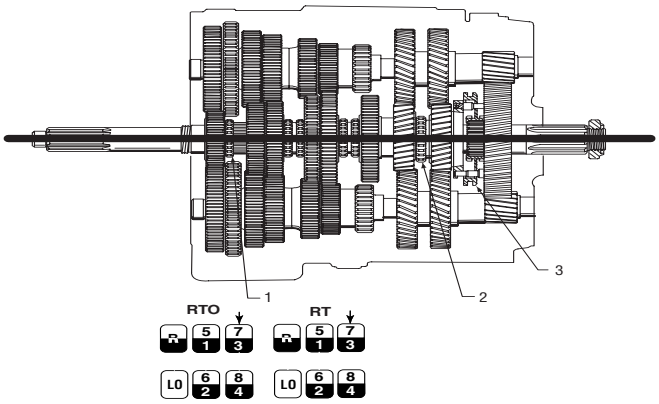
6th - High Split Gear

1. Sliding Clutch forward
2. Sliding Clutch rearward
3. Sliding Clutch forward



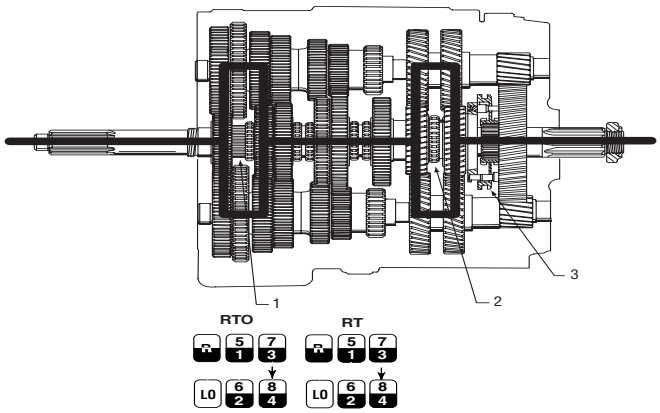
7th - Low Split Gear

1. Sliding Clutch forward
2. Sliding Clutch forward
3. Sliding Clutch forward



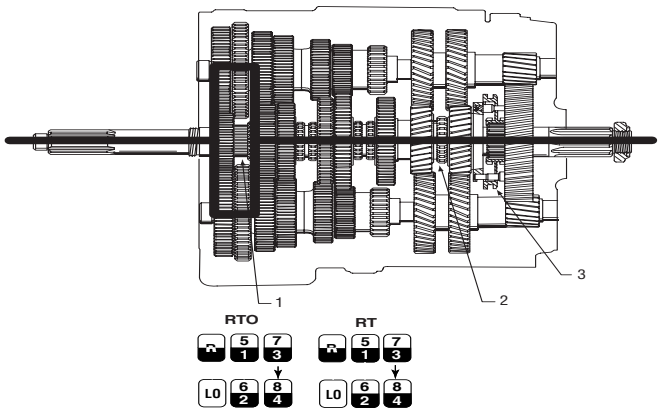
7th - High Split Gear

1. Sliding Clutch forward
2. Sliding Clutch rearward
3. Sliding Clutch forward



8th - Low Split Gear

1. Sliding Clutch rearward
2. Sliding Clutch forward
3. Sliding Clutch forward



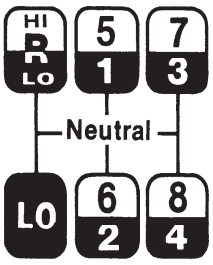
8th - High Split Gear

1. Sliding Clutch rearward
2. Sliding Clutch rearward
3. Sliding Clutch forward

9 & 13 Speed Shift Patterns

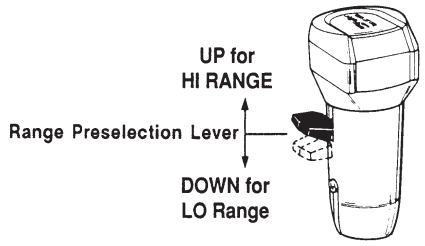
9-Speed Transmissions (Shift Lever Patterns and Shifting Controls)

RT (Direct) Models



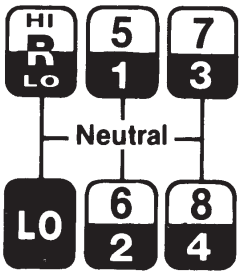
Shift LO-1-2-3-4 in LO Range
Range shift . . .
And shift 5-6-7-8 in HI Range.

Roadranger Valve
(A-5010)



13-Speed Overdrive Models (Shift Lever Patterns and Shifting Controls)

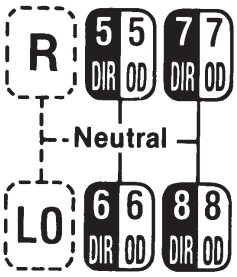
RTO (Overdrive) Models



With Splitter Control Button in "DIR."/REARWARD position . . .
Shift LO-1-2-3-4 in LOW RANGE.

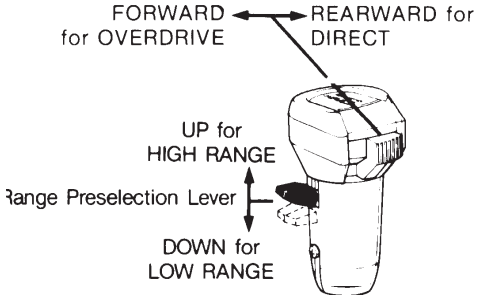
Range shift . . .

And shift 5.6-7-8 in HIGH RANGE (Direct).



WHILE IN HIGH RANGE ONLY . . .
Ratios can be split by moving Splitter Control Button to the "O.D."/ FORWARD position to gain OVERDRIVE 5-6-7-8.

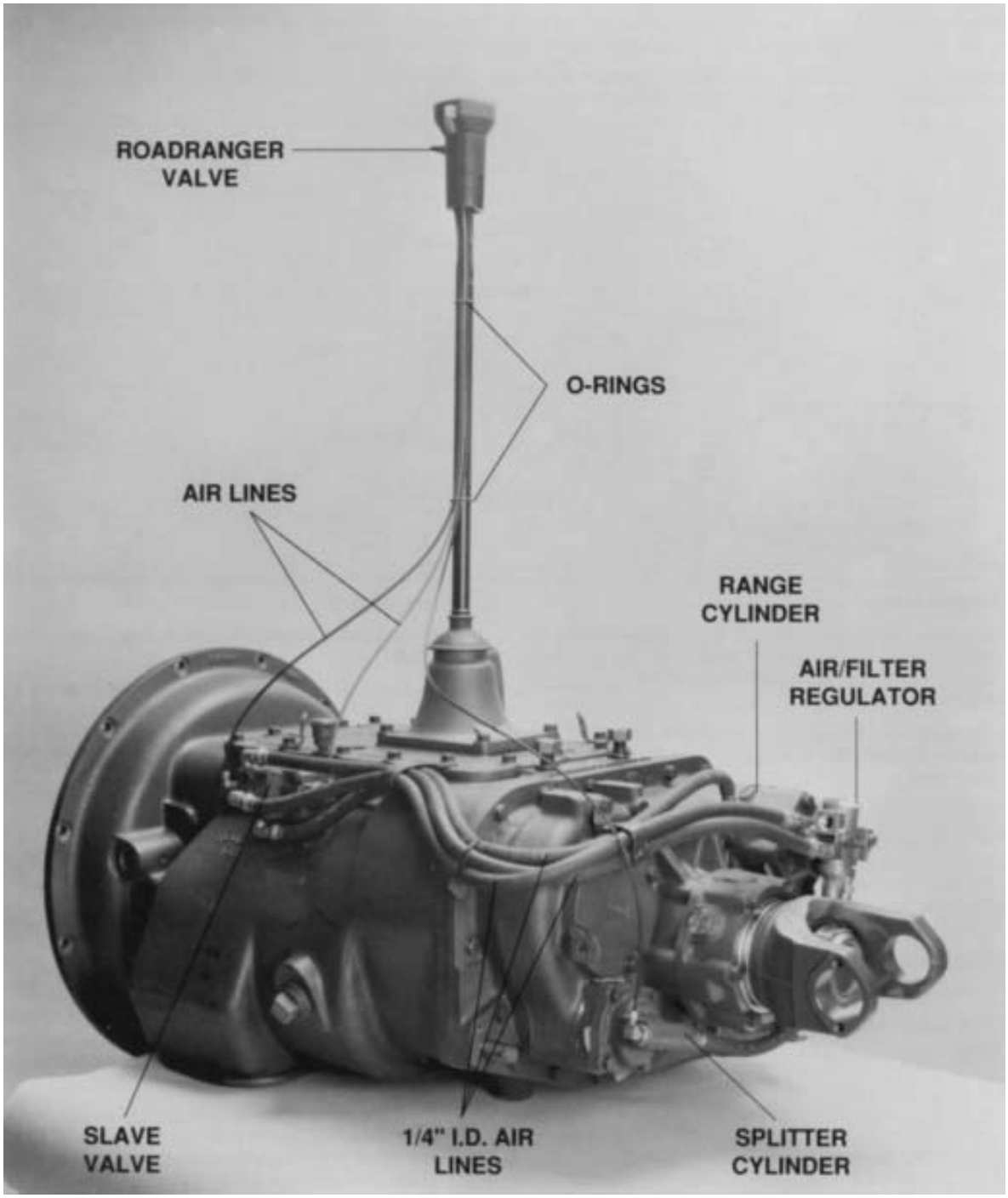
Roadranger Valve (A-4900)



SPLITTER CONTROL BUTTON

Air System Overview

Pressurized air from the vehicle's air system is used to shift the transmission low/high range and low/high split. The low/high range and low/high split gearing and shift mechanisms are located in the auxiliary section of the transmission. The vehicle operator controls these shifts with two separate switches on the shift knob (master control valve). The following components are part of the air shift systems.



Range System Operation

The range shift air system consists of the air filter/ regulator, slave valve, a range control valve or master control valve, range cylinder, fittings and connecting air lines.

Constant air from the air filter/regulator is supplied to the "S" or supply port of slave valve and passed through to the inlet or "S" port of control valve.

While in LO range, the control valve is open and air is returned to slave valve at the "P" or end port. This signals the valve to supply air in line between the LO range or "L" port of slave valve and the LO range port of range cylinder housing. Air received at this port moves the range piston to the rear and causes the auxiliary LO range gear to become engaged.

While in HI range, the control valve is closed and no air is returned to the slave valve. This signals the slave valve to supply air in line between the HI range or "H" port of valve and the HI range port of range cylinder cover. Air received at this port moves the range piston forward to engage the auxiliary drive gear with sliding clutch and bypass the LO range gear set.

Range shifts can be made only when the gearshift lever is in, or passing through, neutral. Thus, the range desired can be preselected while the shift lever is in a gear position. As the lever is moved through neutral, the actuating plunger in the shift bar housing releases the slave valve, allowing it to move to the selected range position.

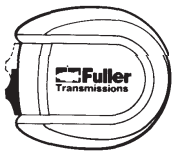
Splitter System Operation

In addition to the various components of the range shift air system, the splitter shift air system utilizes a splitter cylinder and the Roadranger valve A-4900.

Constant air from the air filter/regulator assembly is supplied to the splitter cylinder at the port on right side of cylinder cover. The insert valve installed in the cover provides the proper air flow needed to move the splitter piston in the cylinder (rearward to engage rear auxiliary drive gear for operation in direct; forward to engage the front auxiliary drive gear for operation in overdrive).

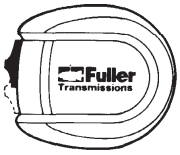
While in HI or LO range, air needed to make the splitter selection and complete the shift is supplied to the Roadranger valve from the tee fitting at the HI range or "H" port of the slave valve. When the overdrive selection is made, the air passes through the Roadranger valve and is supplied to the left port of cylinder cover.

With splitter control button in the "DIRECT"/REARWARD position, the "SP" port of the Roadranger valve is closed and no air is supplied to the left port of the splitter cylinder cover.



Button REARWARD ("SP" Port Closed)

While in HI range, the button can be moved forward to operate in overdrive. The "SP" port of valve is opened when overdrive is selected, supplying air to the left port of the splitter cylinder cover.



Button FORWARD ("SP" Port Opened)

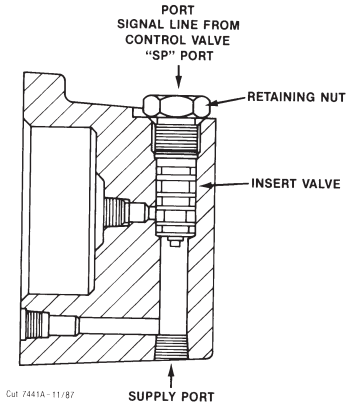
Insert Valve (Equipped with Roadranger Valve A-4900)

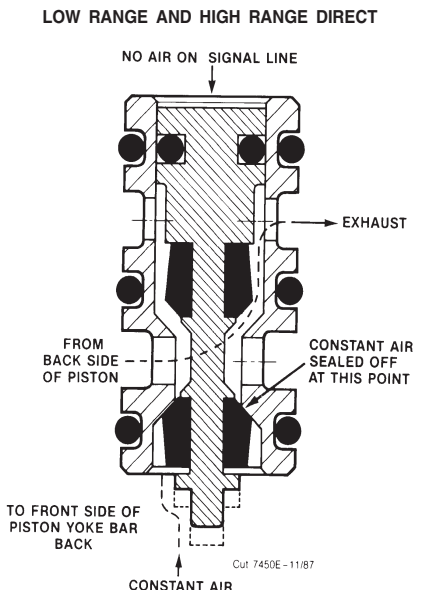
The insert valve is a self-contained 1- 3/16" valve assembly located in the splitter cylinder cover. It **cannot** be disassembled except for the three O-rings on the outer diameter. The O-rings provide a stationary seal and do not move in the cylinder.

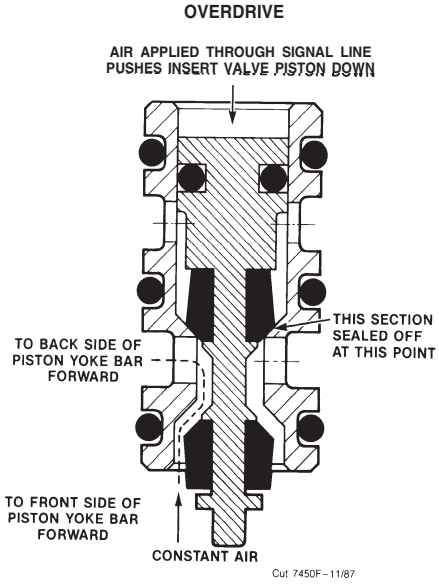
When installing the insert valve in the bottom edge of the cover, apply Fuller #71206 silicone lubricant or its equivalent to the O-rings and cylinder walls. Install the valve in the bore with the flat surface to the outside. When installing the special valve retaining nut, apply Fuller #71204 adhesive/sealant or its equivalent to the threads and tighten. See torque specifications.

Travel of the small insert valve piston is only 3/16". As shown in the illustrations below, when no air is applied to the top side of valve piston, constant air supplied from the regulator passes to the front side of cylinder piston, moving the yoke bar backward to engage the rear auxiliary drive gear (LO Range DIRECT and HI Range DIRECT). The piston moves up to cut off air to the back side of the cylinder piston. This air is exhausted out the cylinder cover as the piston moves rearward.

When air is applied to top side of valve piston, through the signal line, the piston moves down passing air through the bottom of the insert valve to the front and backside of the cylinder piston, moving the yoke bar forward engaging the front auxiliary drive gear (HI Range overdrive).



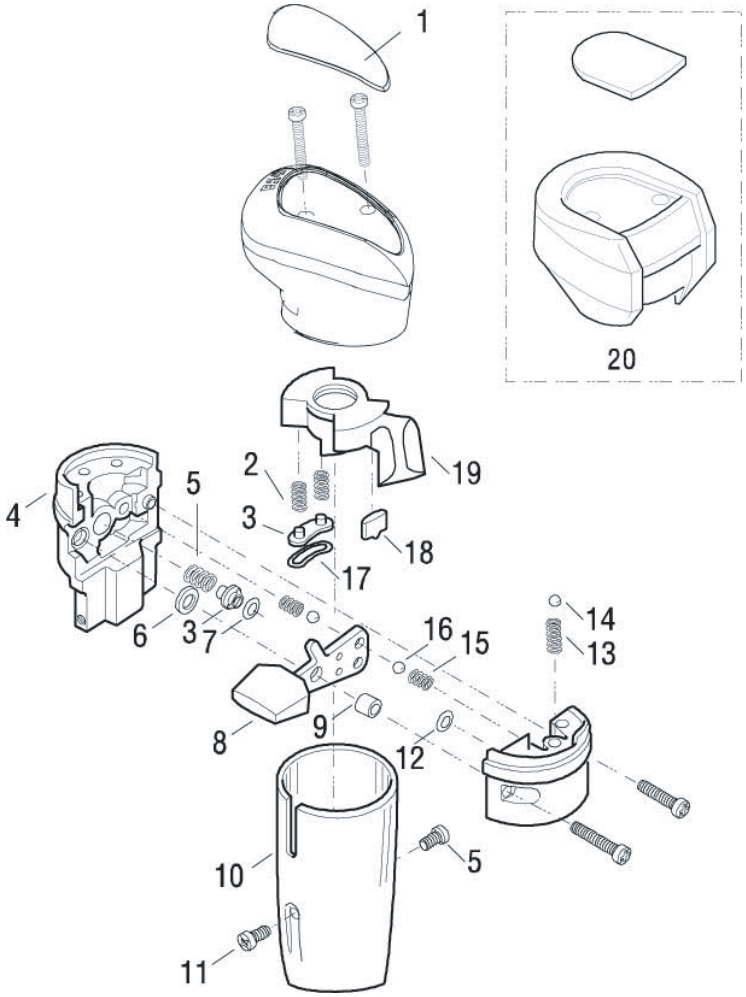




Shift Knob 13-Speed

The shift knob contains two switches.

- The range selector lever on the front of the knob is moved down to select low range. When the range selector lever is moved up, high range is selected.
- The splitter button or the button on the side of the shift knob is moved rearward to select LO split and forward for HI split of each lever position. When in LO range a mechanical interlock prevents moving the splitter button to HI.



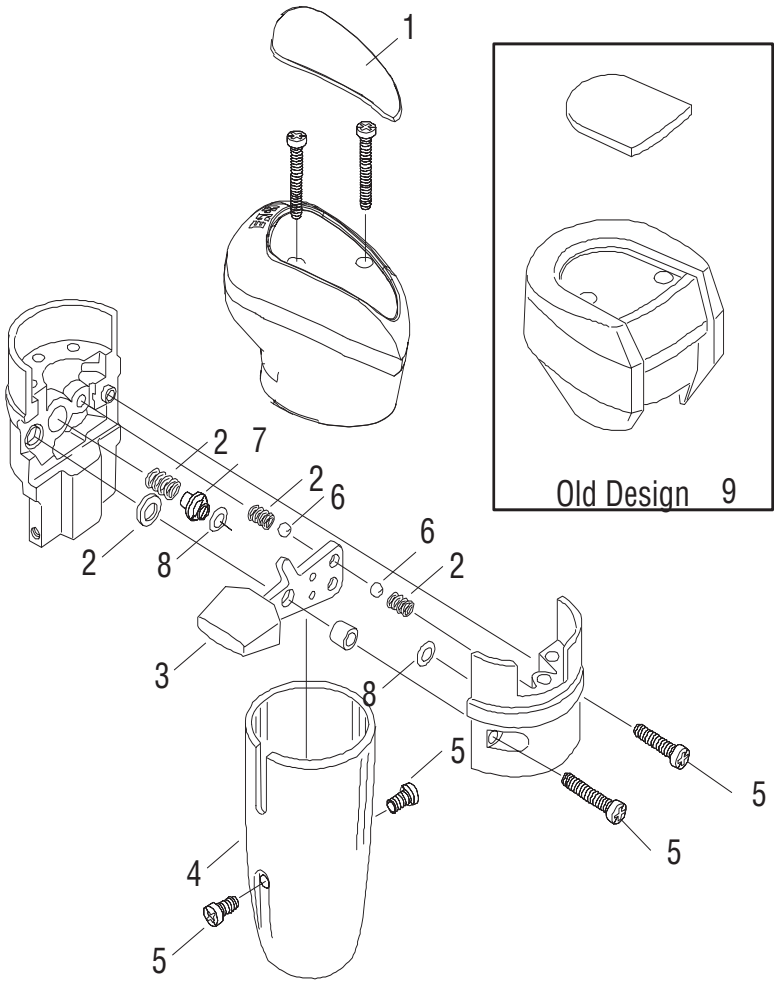
Component Nomenclature and Auxiliary Countershaft Sectional View

1. Medallion
2. Spring
3. Retainer
4. Housing
5. Spring
6. Washer
7. O-Ring
8. Range Selector
9. Pin
10. Cover
11. Screw
12. O-Ring
13. Spring
14. 5/32” Ball
15. Spring
16. Ball
17. Seal
18. Detent
19. Splitter Button
20. Old Style Shift Knob

Shift Knob 9-Speed

This shift knob contains one switch.

- The range selector lever on the front of the knob is moved down to select low range. When the range selector lever is moved up, high range is selected.

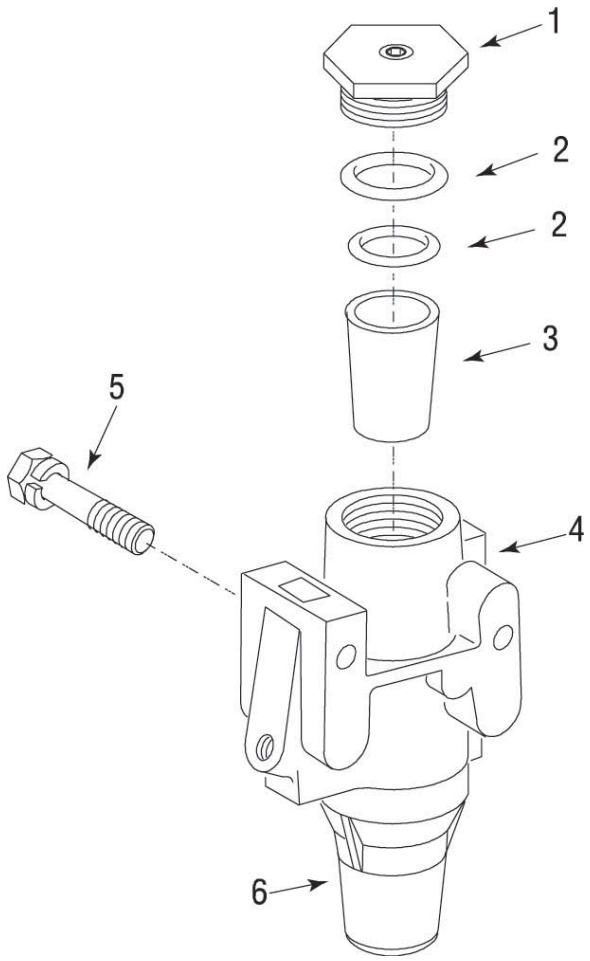


Component Nomenclature and Auxiliary Countershaft Sectional View

1. Medallion
2. Spring
3. Lever
4. Cover
5. Screw
6. Ball 5/32"
7. Retainer
8. O-Ring

Air Filter/Regulator

The filter/regulator assembly filters the vehicle supply air and regulates the pressure to 58 - 63 PSI. Two holes in the front face of the filter/regulator assembly supply air to the range cylinder cover. The filter element can be removed by turning out the end cap.

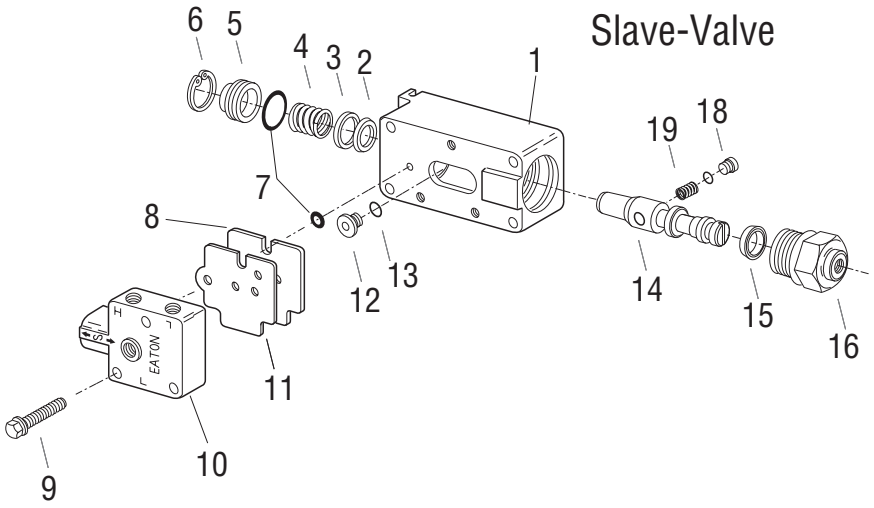


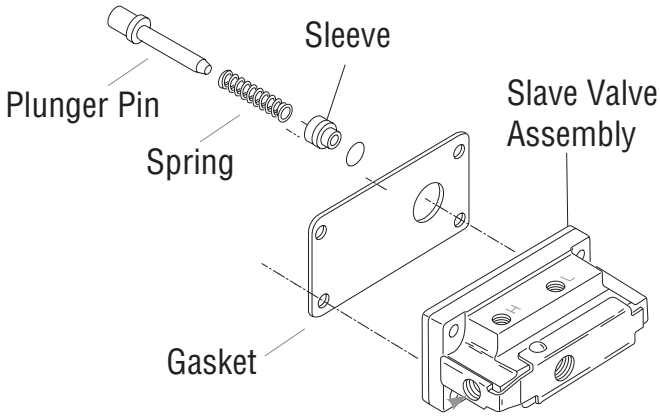
Component Nomenclature and Auxiliary Countershaft Sectional View

1. End Cap
2. O-Rings
3. Filter Element
4. Housing
5. Capscrews
6. Air Regulator

Slave Valve

The slave valve controls the supply of air to the low and high range sides of the range shift cylinder. A small air line from the shift knob (master control valve) provides a signal pressure to the slave valve.





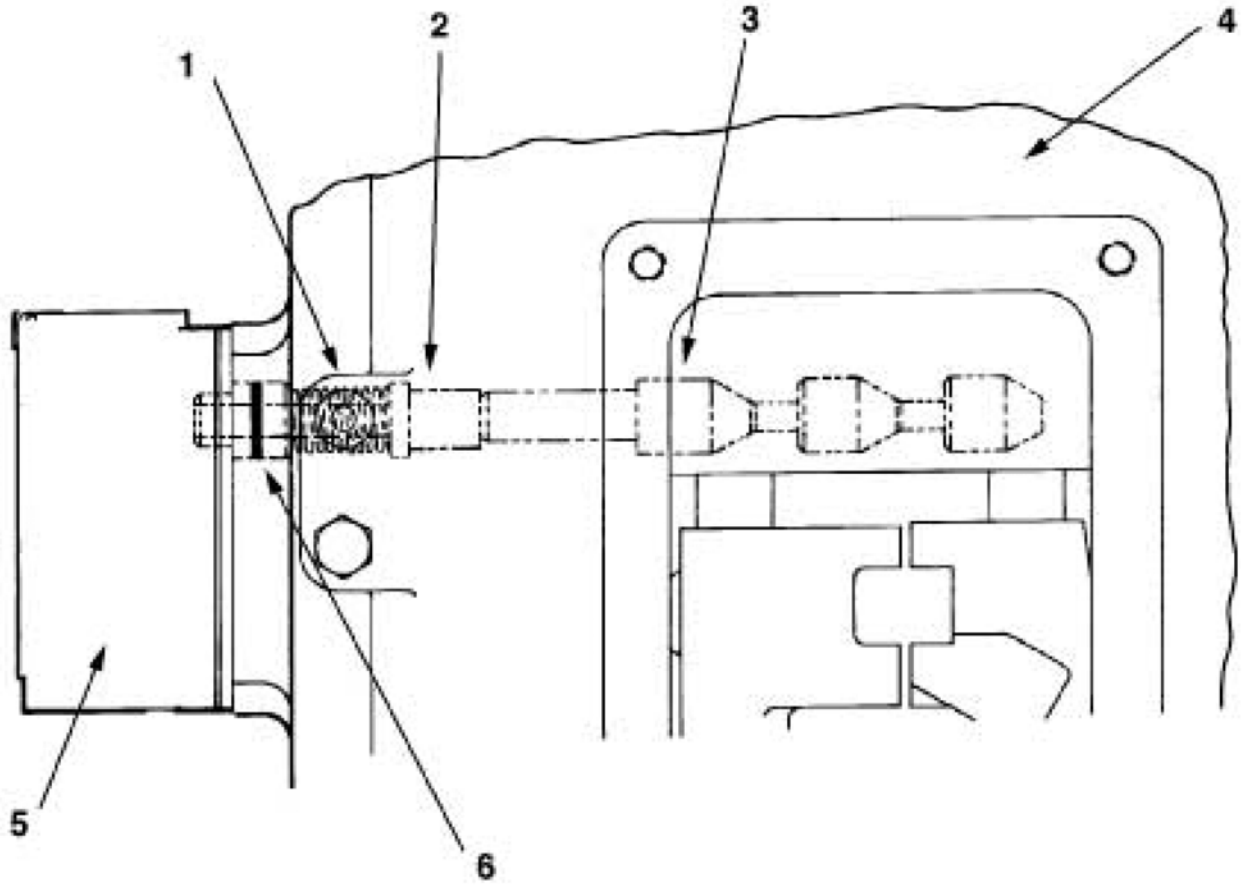
Poppet-Type

Component Nomenclature and Auxiliary Countershaft Sectional View

1. Slave Valve Housing
2. "U" Seal
3. Washer
4. Spring
5. Plug
6. Snap Ring
7. O-Rings
8. Plate
9. Capscrew
10. Cap
11. Gasket
12. Seal
13. O-Ring
14. Piston
15. "U" Seal
16. Cap
17. O-Ring
18. Seal
19. Spring

Slave Valve Preselection System

This interlock mechanism prevents the slave valve from shifting when the transmission is engaged into gear. The air valve shaft is moved towards the slave valve by the shift rails when the transmission is shifted into gear. A spring pushes the air valve shaft back when the front section is shifted into a neutral position.



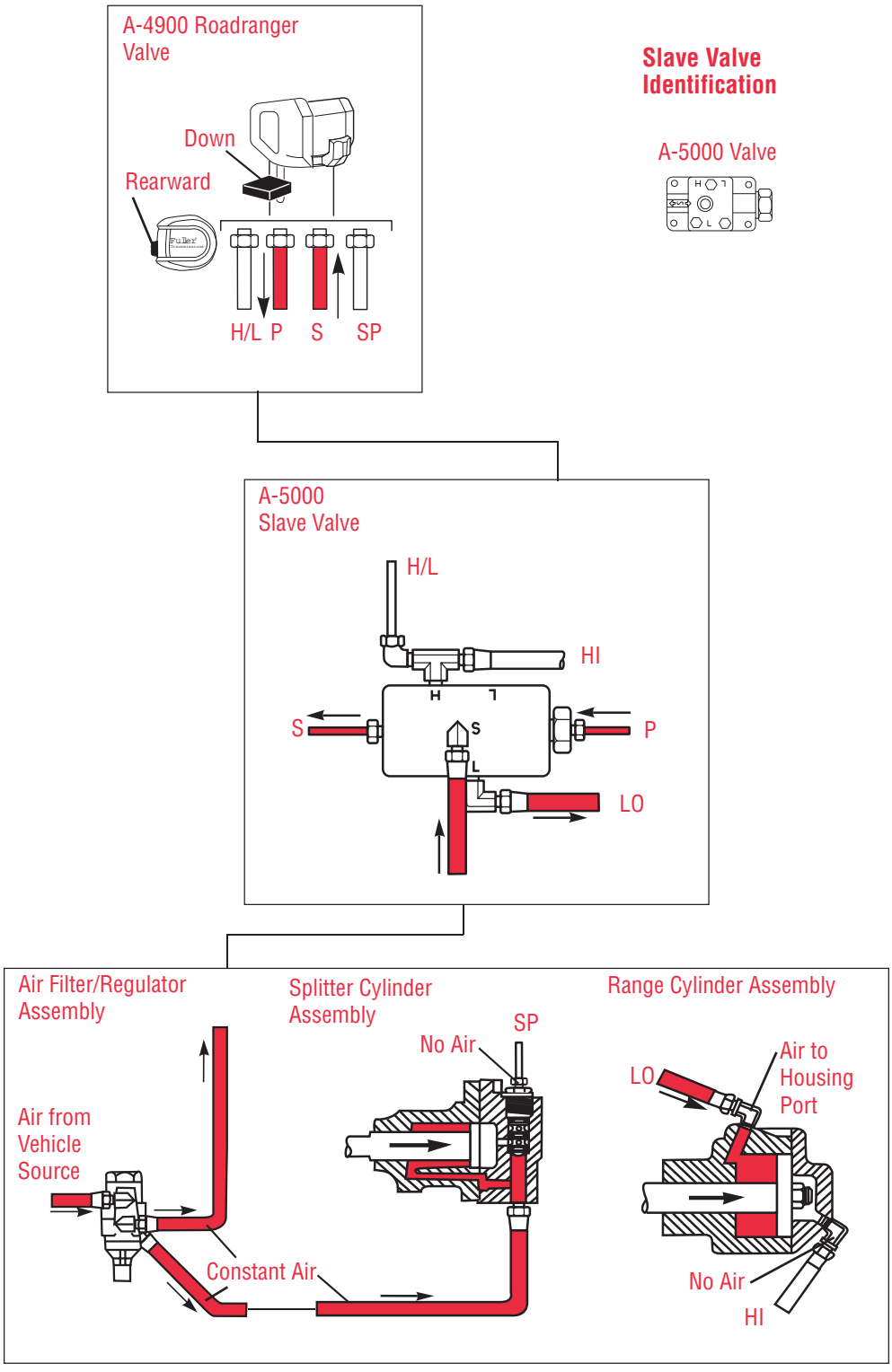
Component Nomenclature and Auxiliary Countershaft Sectional View

1. Actuation Spring
2. Actuating Pin
3. Air Valve Shaft
4. Shift Bar Housing
5. Slave Valve
6. Alignment Sleeve

Refer to the drawing for disassembly and reassembly of the piston-type slave valve assemblies. Should the poppet-type slave valve assembly prove to be defective, replace the complete assembly, as it is non-serviceable. The actuating components used with these valve assemblies are non-interchangeable. Failure to use the correct plunger pin, spring, and alignment sleeve during installation on the transmission will cause hard shifting in LO Range gears.

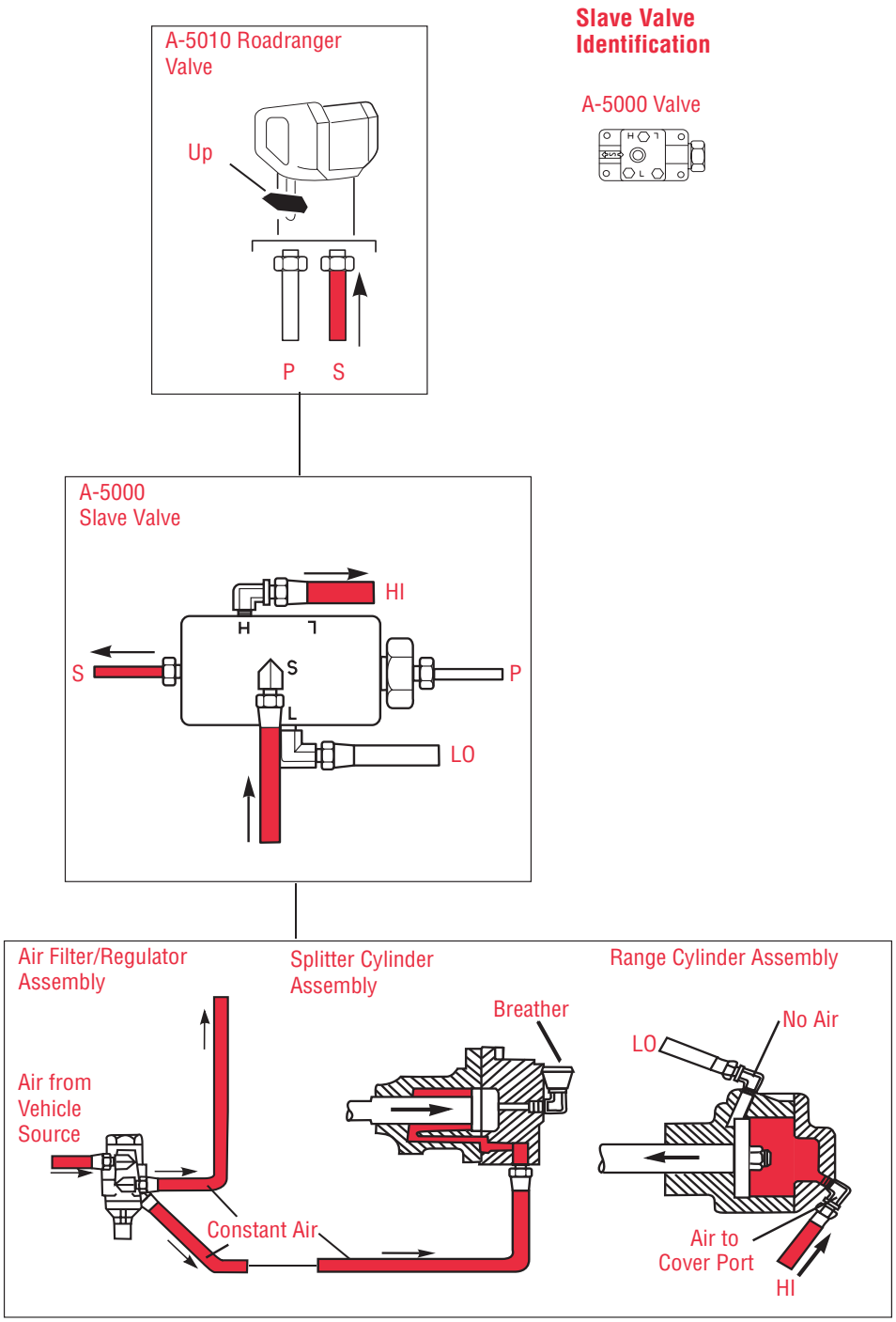
RTLC-1X909 (2-Speed Auxiliary)

Range-LO



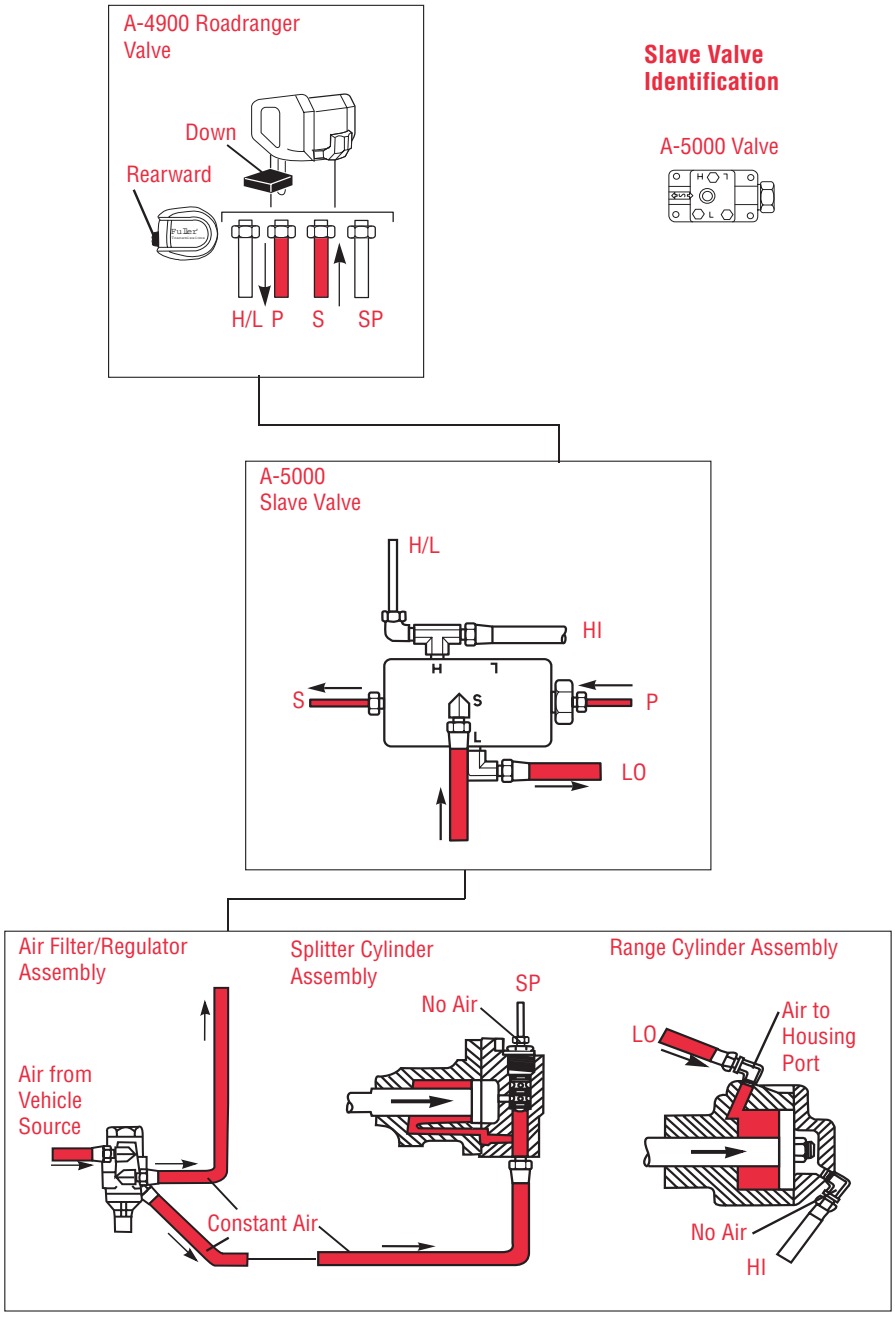
RTLC-1X909

Range-HI



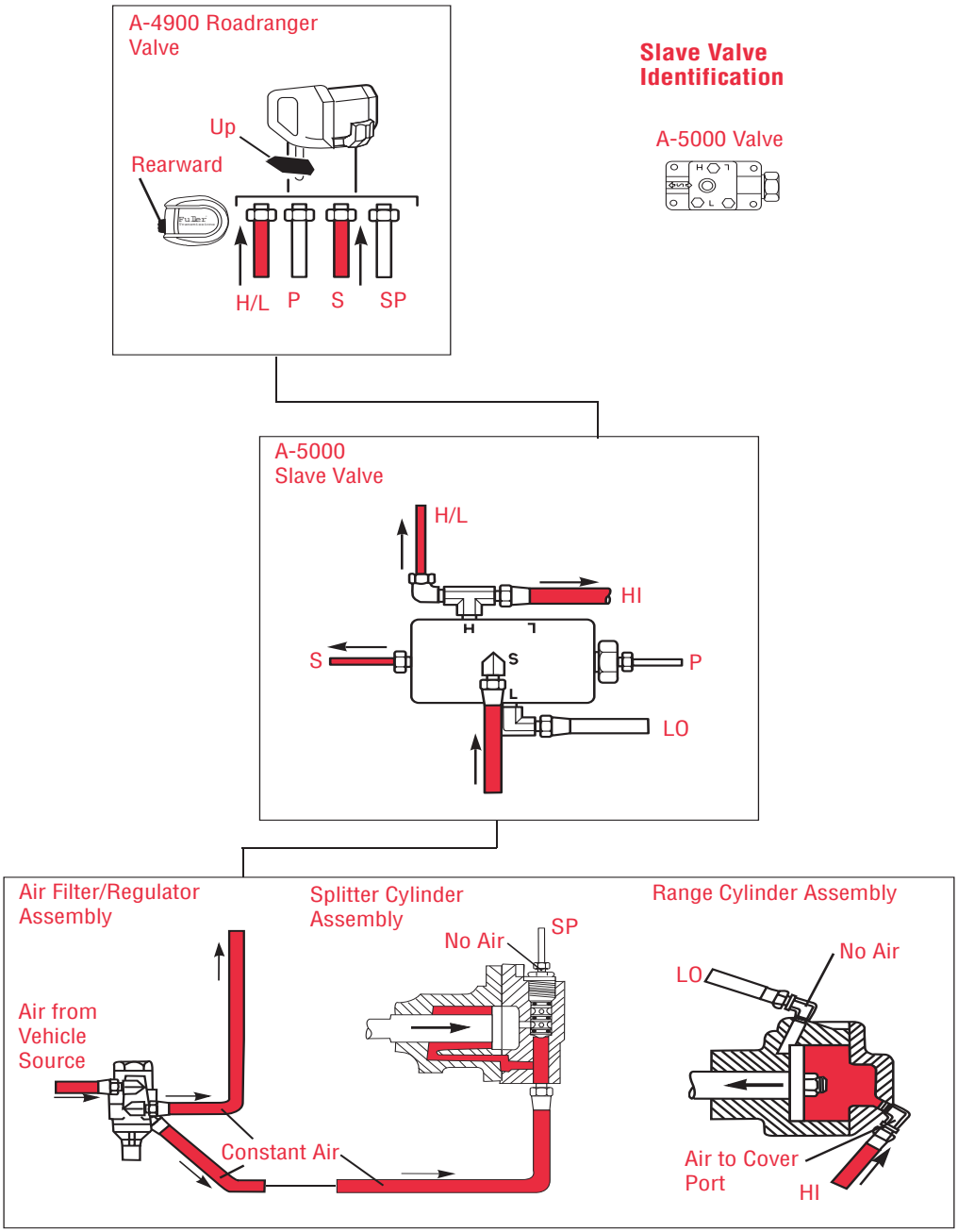
RTLO-1X913

LO-Range



RTLO-1X913

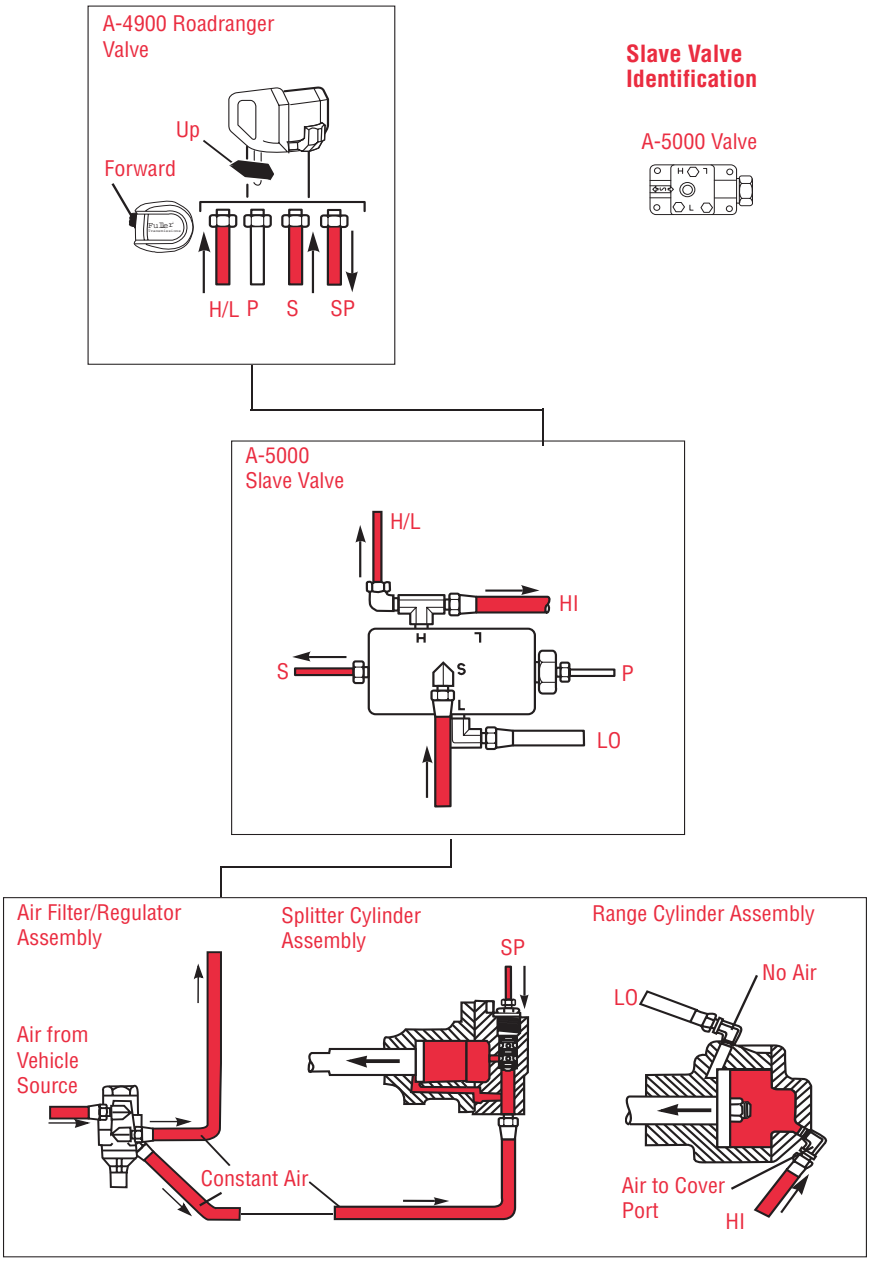
HI Range L



RTLO-1X913

HI Range H

HI Range H



General Troubleshooting Chart

The chart on the following pages contains some of the most common problems that may occur with this transmission along with the most common causes and solutions.

Complaint	Cause	Corrective Action
Noise - Growl / Rumble	Torsional Vibration. [Noise may be most pronounced when transmission is in a “float” (low torque) condition. May also be confined to a particular vehicle speed.]	Check driveline angles for proper u-joint working angles. Check driveline for out of balance or damage. Check u-joints for proper phasing. Check clutch assembly for broken damper springs. Check for inadequate clutch disc damping.
	Transmission bearing or gear failure. [Noise may be most pronounced under hard pull or coast (high torque).]	Check transmission oil for excessive metal particles.
Noise - Growl / Rumble at Idle (Idle Gear Rattle)	Excess engine torsional vibration at idle.	Check for low engine RPM. Check for uneven engine cylinder performance. Check for proper clutch damper operation.
Noise - High Pitched Whine	Gear Noise. Isolate as to axle or transmission noise. If transmission, isolate to specific gear or gears.	Check for worn or defective shift lever isolator. Check for direct cab or bracket contact with transmission (“grounding”). Check for proper driveline u-joint working angles. Check for damaged or worn gearing.

General Troubleshooting Chart (cont)

Complaint	Cause	What to do next
Hard Lever Shifting (Shift lever is hard to gear into or out of gear)	Master clutch dragging.	Check master clutch for proper disengagement. Check master clutch for proper adjustment (both release bearing travel and clutch brake height).
	Shift linkage problem. (Remote shifter)	Check shift linkage or cables for proper adjustment, binding, lubrication, or wear.
	Shift bar housing problem.	Check shift bar housing components for binding, wear, or damage.
	Transmission mainshaft problem.	Check mainshaft for twist. Check sliding clutches for binding, damage, or excessive wear.
	Driver technique.	Driver not familiar or skilled with proper double-clutching technique. Driver contacting the clutch brake during shifts.
Shift Lever Jumpout (Shift lever comes out of gear on rough roads)	Loose or worn engine mounts.	Check engine mounts for damage, wear, or excessive looseness.
	Shift lever problem.	Check shift lever floor boot for binding or stretching. Check shift lever isolator for excessive looseness or wear. Check for excessive offset or overhang on the shift lever. Check for extra equipment or extra weight added to shift lever or knob.
	Worn or broke detent spring or mechanism.	Check for broken detent spring. Check for excessive wear on the detent key of detent plunger. Replace detent spring with heavier spring or add additional spring.

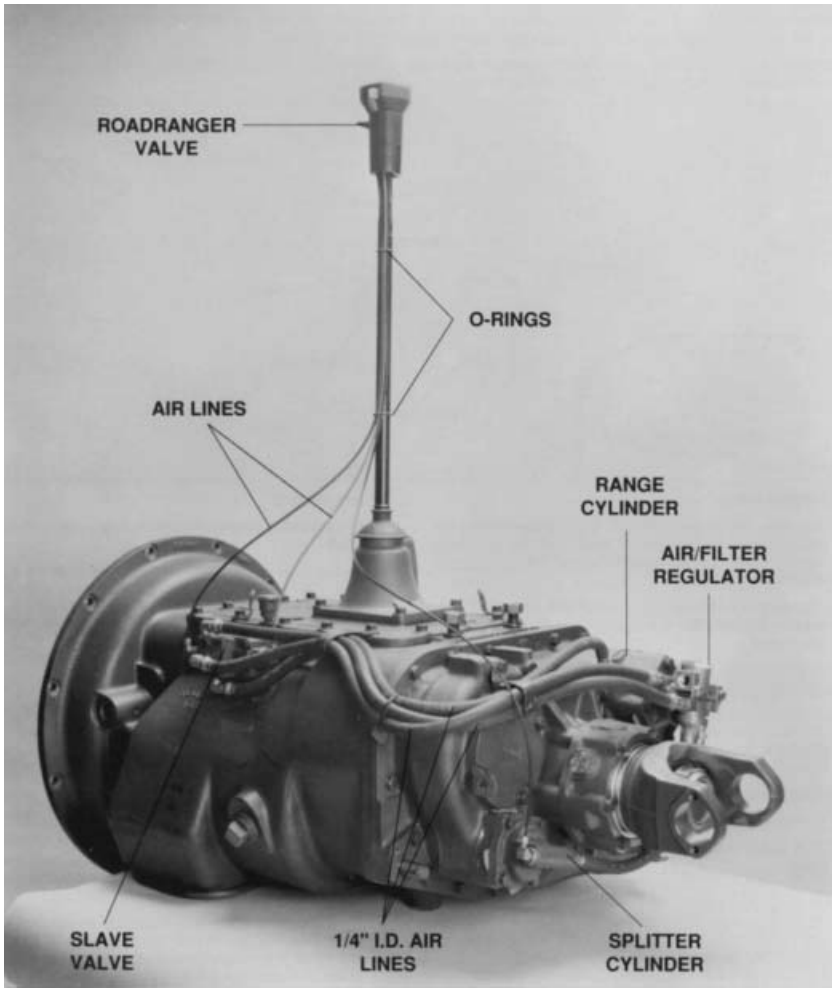
General Troubleshooting Chart (cont)

Complaint	Cause	Corrective Action
Shift Lever Slipout (Transmission comes out of gear under torque)	Internal transmission problem.	Check for excessively worn or damaged sliding clutches or shift yokes.
Transmission goes to neutral (Shift lever doesn't move)	Low air pressure.	Check air regulator pressure.
	Internal transmission problem.	Check for excessively worn or damaged range sliding clutch or yoke.
No range shift or slow range shift (Also see Air System Troubleshooting)	Transmission air system problem.	Preform air system troubleshooting procedure. Check for proper air signal from master valve. Check air module test ports for proper air delivery.
	Range cylinder problem.	Check for failed or damaged range piston, piston bar, or cylinder. Check for failed or loose range piston snap ring.
	Range yoke assembly problem.	Check for failed or damaged range yoke. Check for failed or loose range yoke snap rings. Check for excessively long fastener installed in rear support hole. Check for binding between range yoke bar and range alignment lock cover.
	Range synchronizer problem.	Check for failed or damaged range synchronizer, sliding clutch, or mating gear. Check for excessively worn range synchronizer friction material.
Grinding Noise on Range Shift	Driver not preselecting range shift.	Instruct driver to preselect range shifts.
	Range synchronizer worn or defective.	Check range synchronizer and mating parts for excessive wear or damage.

Air System Troubleshooting

⚠ WARNING

Use care when removing air lines or checking for air flow from disconnected lines. High pressure air may exhaust suddenly. Wear safety glasses. Exhaust all air pressure from system before removing air filter/regulator or combination cylinder cover.



Note: During all testing, the vehicle air pressure must be greater than 90 PSI (620 kPa). If during testing the pressure falls below 90 PSI (620 kPa), make sure the transmission is in neutral, start the engine and let the pressure build to governor cutoff. After the pressure reaches the governor cutoff, continue testing. The pressure is critical if the vehicle is equipped with a vehicle air system Pressure Protection Valve that would shut off the air supply to certain air circuits if the system pressure dropped below a preset level.

⚠ IMPORTANT

Use the following air system troubleshooting procedures for part replacement only if the symptom can be duplicated. If the problem is intermittent, parts that are not defective could be replaced.

Instructions

1. Start at “Procedures” for Step A.
2. Based on the “Result” of the procedure, go to the corresponding “What To Do Next”.

Procedure 1: Symptom - Air Leak at Shift Knob

Normal Operation:

- A burst of air will be exhausted from the shift knob when moving the range selector from low to high. This is the air being exhausted from the “P” air line.
- A burst of air will be exhausted from the shift knob when moving the splitter button rearward (shifting to low split). This is the air being exhausted from the “SP” air line.

Possible Causes:

- Incorrectly attached air lines
- Internal leak in slave valve
- Internal leak at insert valve
- Internal leak at shift knob

Table 10 Air Leak at Shift Knob

	PROCEDURE	RESULT	WHAT TO DO NEXT
Step A	Remove lower skirt on shift knob. Check for leaking fitting at the shift knob.	Leak found.	Repair leaking fitting or air line.
		No leak found.	Go to Step B.
Step B	Check air lines to make sure all lines are connected to the proper ports on the shift knob.	Air lines are not connected to the proper ports.	Connect lines properly.
	A.) Reversal of “S” and “P” lines will result in a constant leak from the exhaust when high range is selected. B.) Reversal of the H/L and “SP” lines will result in a constant leak when the splitter button is rearward.	Air lines are connected to the proper ports.	Go to Step C.
Step C	Move the range selector lever down to Low range. Check for constant air flow from the exhaust “E” port.	Constant air flow from the “E” port.	Replace knob.
		No air flow from “E” port.	Go to Step D.
Step D	Move the range selector up to high range. Disconnect the small air line connected to the “P” port of the shift knob. Check for air flow from the port and air line.	Constant air is leaking from the “P” port or the “E” port.	Repair or replace the shift knob.
		Air is coming out of the disconnected air line.	1. Verify that the air line is connected to the slave valve “p” port. 2. If properly connected, replace the slave valve.
		Air is not leaking from either port or disconnected air line.	Go to Step E.

Table 10 Air Leak at Shift Knob (Continued)

	PROCEDURE	RESULT	WHAT TO DO NEXT
Step E	Reattach the air line to the “P” port. Move the range selector down to low range and move the splitter button rearward. Disconnect line from the “SP” port. Check for air flowing from the SP port on the shift knob.	Air is flowing from the SP line.	1. Check to make sure the “SP” line is connected to the splitter cylinder cover. 2. If the line is properly attached, check that the insert valve (old style) is properly installed (stem facing inward) and that the insert valve bore is not defective. 3. Replace the insert valve.
		Air is not flowing from the line.	Repair or replace the shift knob.

Procedure 2: Symptom - Air Leak at Slave Valve

Normal Operation:
A momentary exhaust of air at the slave valve occurs during a range shift. The air from the low side of the range cylinder is exhausted as air pressure is applied to the high range side. Likewise, air from the high range side of the piston is exhausted as air pressure is applied to the low range side. The exhaust port is located at the slave valve to transmission mounting interface.

Possible Causes:

- Internal leak in range cylinder.
- Internal leak in slave valve.

Table 11 Air Leak at Slave Valve

	PROCEDURE	RESULT	WHAT TO DO NEXT
Step A	Confirm that air is leaking from the exhaust port on the slave valve and not a fitting or air line.	Air is leaking from fitting or air line.	Repair or replace fitting or air line.
		Air is definitely leaking from slave valve exhaust port.	Go to Step B.
Step B	Move range selector down to select low range. Remove the 1/4" I.D. rubber air line at the high range supply port on the range cylinder. Feel for air flow from the open port on the range cylinder. Notice if the air leak at the slave valve only occurs when the transmission is in high range. Repeat the above test but remove the low range air hose and check with high range selected.	Air is flowing from high range supply port on range cylinder.	Remove range cylinder cover and repair leaking range piston or piston seal. After repair, check for proper range operation.
		No air flow from high range port.	Repair or replace slave valve.

Procedure 3: Symptom - Air Leak from Transmission Breather or Transmission Case is Pressurized

Normal Operation:
There should be no measurable air flow from the transmission breather.

Possible Causes:

- Leak at range yoke bar o-ring
- Leak at splitter yoke bar o-ring

Table 12 Air Leak from Transmission Breather or Transmission Case is Pressurized

	PROCEDURE	RESULT	WHAT TO DO NEXT
Step A	Listen for the air leak with the transmission shifted to both low and high range.	Leak is only in low range.	Remove range cylinder and inspect for damaged range yoke bar, yoke bar o-ring, or range cylinder. Repair as necessary.
		Leak is in both low and high range.	Remove splitter cylinder. Inspect for damaged splitter yoke bar, o-ring, or cylinder. Repair as necessary.

Procedure 4: Symptom - Air Leak at Splitter Cylinder Cover Exhaust Port

Normal Operation:
A burst of air will exhaust from this port when shifting into low split (the splitter button is moved rearward while in low range).

Possible Causes:

- Damaged/defective insert valve
- Leak past insert valve external o-rings
- Leak past splitter cylinder piston

Table 13 Air Leak at Splitter Cylinder Cover Exhaust Port

	PROCEDURE	RESULT	WHAT TO DO NEXT
Step A (old style)	Remove insert valve. Check for contamination, damaged seals, or sticky movement. Check the insert valve bore in the splitter cylinder cover for contamination or damage which would result in leakage past the insert valve o-rings.	Contamination or damage found.	Repair or replace as necessary.
		No contamination or damage found.	Go to Step B.
Step B	Remove the splitter cylinder cover and piston. Check the piston bore for contamination or damage. Check the piston seals for damage. **Note:** Early production transmissions used a paper gasket to seal the splitter cover to cylinder, if necessary, replace this configuration with the spool valve design which uses an o-ring.	Contamination or damage found.	Repair or replace as necessary.

Procedure 5: Symptom - No or Slow Range Shift into Low

Normal Operation:
When the range selector on the shift knob is moved down to select low range, air pressure will flow through the shift knob to the "P" port on the slave valve. The slave valve will direct air pressure through the low range 1/4" rubber hose to the range cylinder to shift the range. There will be a brief burst of air at the slave valve as the high range side of the range piston exhausts. Likewise, when high range is selected, the air pressure in the "P" will be exhausted at the shift knob. This will cause the slave valve to direct air to the rear side of the range cylinder piston. The air pressure on the low range side will be exhausted at the slave valve.

Possible Causes:

- Incorrect air line hook up
- Insufficient air supply to transmission
- Damaged or defective air filter / regulator assembly
- Damaged or defective shift knob master valve
- Damaged or defective slave valve
- Damaged or defective range cylinder
- Damaged or defective range yoke or yoke bar
- Damaged or defective range synchronizer
- Damaged or defective gearing in auxiliary section of transmission

Table 14 No or Slow Range Shift into Low

	PROCEDURE	RESULT	WHAT TO DO NEXT
Step A	Place the shift lever in neutral. Check for constant air leakage at the shift knob, slave valve, and transmission case breather when both low and high range have been selected.	Constant air leak is detected.	Go to the other corresponding symptom first. See beginning of Air System Troubleshooting section.
		No constant leak is detected.	Go to Step B.
Step B	Place shift lever in neutral. Move range selector up to high range position. At the rear of the transmission, disconnect the 1/4" rubber air line from the low range supply port on the range cylinder. Check for air flow from the low range port.	Air flows from the low range port.	Remove range cylinder cover and repair leaking range piston or piston seal.
		No air flow from low range port.	Go to step C.
Step C	Check for air flow from the disconnected air line.	Air flows from disconnected air line.	Go to step F.
		No air flow from disconnected line.	Go to step D.

Table 14 No or Slow Range Shift into Low (Continued)

	PROCEDURE	RESULT	WHAT TO DO NEXT
Step D	Install a 100 PSI air gauge in the disconnected air line end. With the shift lever in neutral, move the range selector down to select low range. Observe the gauge.	The gauge read 0 PSI.	Go to step F.
		The gauge reads pressure but is lower than 58 PSI or higher than 63 PSI.	Replace the filter/regulator and check for proper range operation.
		The gauge reads between 58-63 PSI.	Go to step E.
Step E	Confirm that shift lever is still in neutral. Have an assistant move the range selector up and down between low and high range. Does the pressure measured at the gauge respond rapidly when going from high to low.	Pressure rapidly changes between 58-63 PSI and 0 at the gauge.	Air system appears to be operating satisfactory. Go to step R.
		Pressure does not change rapidly at gauge.	1. Check for a plugged or dirty filter in the filter/regulator assembly. 2. Check for a pinched or obstructed 1/4" rubber air line between the filter/regulator and slave valve. 3. Check for a pinched or obstructed 1/4" rubber air line between the slave valve and the test gauge. 4. If all are satisfactory, go to step F.
Step F	Place shift lever in neutral. At the shift knob, move the range selection lever up to select high range. At the slave valve, remove the air line from the "P" port. (should be black line). Check for air flow from the disconnected line.	Air flows from the disconnected line.	1. Confirm that the air lines are connected to the correct ports at the shift knob. 2. If the lines are correct, replace the shift knob.
		No air flow from the disconnected line.	Go to step G.
Step G	Check for air flow from the "P" port on the slave valve.	Air flows from this port.	Replace the slave valve.
		No air flow from this port.	Go to step H.

Table 14 No or Slow Range Shift into Low (Continued)

	PROCEDURE	RESULT	WHAT TO DO NEXT
Step H	Place the shift lever in neutral. Install a 100 PSI pressure gauge in line with the "P" line. Move the range selector back and forth from low to high range. The gauge should show rapid pressure change.	The gauge responds slowly.	1. Check for a restricted line between the shift knob and slave valve. 2. If the lines are correct, replace the shift knob. 3. Check for a plugged or dirty filter in the filter / regulator assembly. 4. Check for a pinched or obstructed 1/4" rubber air line between the filter/ regulator and slave valve. 5. Check for a pinched or obstructed air line between the slave valve and the "S" port on the shift knob. 6. If all are good, replace the shift knob.
		The gauge rapidly moves between 58-63 PSI and 0 PSI.	Go to step I.
Step I	If possible, leave air lines attached to slave valve. Unbolt the slave valve from transmission side. Check for free movement of the plunger pin protruding from the case under the slave valve. The pin should extract when the transmission is shifted into gear and retract when shifted into neutral. **Note:** If desired, the slave valve can be actuated and tested while unbolted from the transmission case. The air lines of course, must remain attached.	Actuating plunger pin does not move freely.	1. Remove actuating plunger pin and check for damage. 2. Check for missing or broken spring.
		Actuating plunger pin moves freely.	Repair or replace slave valve and check for proper range operation.

Table 14 No or Slow Range Shift into Low (Continued)

	PROCEDURE	RESULT	WHAT TO DO NEXT
Step R	If air system has been tested and found to operate satisfactory, the auxiliary section must be removed to inspect for mechanical problem. Remove auxiliary section and inspect for: • Binding of range yoke bar or piston • Damaged or defective range yoke • Damaged or defective range synchro nizer • Cracked c/s weld resulting in gear turning on shaft • Damaged or defective range sliding clutch • Auxiliary section gearing out of time		

Procedure 6: Symptom - No or Slow Range Shift into High

Normal Operation:
When the range selector on the shift knob is moved down to select low range, air pressure will flow through the shift knob to the 'P" port on the slave valve. The slave valve will direct air pressure through the low range 1/4" rubber supply hose to the range cylinder to shift the range. There will be a brief burst of air at the slave valve as the high range side of the range piston exhausts.

Likewise, when high range is selected, the air pressure in the "P" will be exhausted at the shift knob. This will cause the slave valve to direct air to the rear side of the range cylinder piston. The air pressure on the low range side will be exhausted at the slave valve.

Possible Causes:

- Incorrect air line hook up
- Insufficient air supply to transmission
- Plugged filter
- Incorrect regulator pressure
- Damaged or defective shift knob master valve
- Damaged or defective slave valve
- Damaged or defective range cylinder
- Damaged or defective range yoke or yoke bar
- Damaged or defective range synchronizer
- Damaged or defective gearing in auxiliary section of transmission

Table 15 No or Slow Range Shift into High

	PROCEDURE	RESULT	WHAT TO DO NEXT
Step A	Place the shift lever in neutral. Check for constant air leakage at the shift knob, slave valve, and transmission case breather when both low and high range have been selected.	Constant air leak is detected.	Go to the other corresponding symptom first. See beginning of Air System Troubleshooting section.
		No constant leak is detected.	Go to Step B.
Step B	Place shift lever in neutral. Move range selector down to low range position. At the transmission rear, disconnect the 1/4" rubber air line from the range cylinder high range supply port. Check for air flow from the cylinder high range port.	Air flows from the high range port.	Remove range cylinder cover and repair leaking range piston or piston seal. After repair, check for proper range operation.
		No air flow from high range port.	Go to step C.
Step C	Check for air flow from the disconnected air line.	Air flows from disconnected air line.	Go to step F.
		No air flow from disconnected line.	Go to step D.

Table 15 No or Slow Range Shift into High (Continued)

	PROCEDURE	RESULT	WHAT TO DO NEXT
Step D	Install a 100 PSI air gauge in the disconnected air line end. With the shift lever in neutral, move the range selector up to select high range. Observe the gauge.	The gauge reads 0 PSI.	Go to step F.
		The gauge reads pressure but is lower than 58 PSI or higher than 63 PSI.	Replace the filter/regulator and check for proper range operation.
		The gauge reads between 58-63 PSI.	Go to step E.
Step E	Confirm that shift lever is still in neutral. Have an assistant move the range selector up and down between low and high range. Does the pressure measured at the gauge respond rapidly when going from high to low.	Pressure rapidly changes between 58-63 PSI and 0 at the gauge.	Air system appears to be operating satisfactory. Go to step R.
		Pressure does not change rapidly at gauge.	1. Check for a plugged or dirty filter in the filter/regulator assembly. 2. Check for a pinched or obstructed 1/4" rubber air line between the filter/regulator and slave valve. 3. Check for a pinched or obstructed 1/4" rubber air line between the slave valve and the test gauge. 4. If all are satisfactory, go to step F.
Step F	Place shift lever in neutral. At the shift knob, move the range selection lever up to select high range. At the slave valve, remove the air line from the "P" port. (should be black line). Check for air flow from the disconnected line.	Air flows from the disconnected line.	1. Confirm that the air lines are connected to the correct ports at the shift knob. 2. If the lines are correct, replace the shift knob.
		No air flow from the disconnected line.	Go to step G.
Step G	Check for air coming out of the slave valve "P" port.	Air flows from this port.	Replace the slave valve.
		No air flow from this port.	Go to step H

Table 15 No or Slow Range Shift into High (Continued)

	PROCEDURE	RESULT	WHAT TO DO NEXT
Step H	Place the shift lever in neutral. Install a 100 PSI pressure gauge in line with the "P" line. Move the range selector back and forth from low to high range. The gauge should show rapid pressure change.	The gauge responds slowly.	1. Check for a restricted line between the shift knob and slave valve.
			2. Check for a restricted exhaust port on the shift knob.
			3. Check for a plugged or dirty filter in the filter/regulator assembly.
			4. Check for a pinched or obstructed 1/4" rubber air line between the filter/ regulator and slave valve.
			5. Check for a pinched or obstructed air line between the slave valve and the "S" port on the shift knob.
			6. If all are good, replace the shift knob.
		The gauge rapidly moves between 58-63 PSI and 0 PSI.	Go to step I.
Step I	If possible, leave air lines attached to slave valve. Unbolt the slave valve from transmission side. Check for free movement of the plunger pin protruding from the case under the slave valve. The pin should extract when the transmission is shifted into gear and retract when shifted into neutral. If desired, the slave valve can be actuated and tested while unbolted from the transmission case. The air lines of course, must remain attached.	Actuating plunger pin does not move freely.	1. Remove actuating plunger pin and check for damage.
			2. Check for missing or broken spring.
		Actuating plunger pin moves freely.	Repair or replace slave valve and check for proper range operation.

Table 15 No or Slow Range Shift into High (Continued)

	PROCEDURE	RESULT	WHAT TO DO NEXT
Step R	If air system has been tested and found to operate satisfactory, the auxiliary section must be removed to inspect for mechanical problem. Remove auxiliary section and inspect for: • Binding of range yoke bar or piston • Damaged or defective range yoke • Damaged or defective range synchronizer • Cracked c/s weld resulting in gear turning on shaft • Damaged or defective range sliding clutch • Auxiliary section gearing out of time		

Procedure 7: Symptom - Range Shifts with Shift Lever in Gear

Normal Operation:
Range shift should only occur when the shift lever is in neutral. The range selector can be moved up or down while the shift lever is in a gear position, but the shift will not occur until the shift lever is moved to neutral.

Possible Causes:

- Worn or missing actuating pin or air valve shaft
- Worn shift rail

Procedure:
If the range has been confirmed to shift with the shift lever in gear, unbolt the slave valve from the side of the transmission. Confirm that the actuating pin is present and that it is the proper P/N for the corresponding slave valve. If correct, remove the shift bar housing assembly and check for a worn or damaged air valve shaft or worn shift rails. Replace necessary parts.

Timing Procedures

Special Instructions

It is essential that both countershaft assemblies of the front and auxiliary sections are "timed." This assures proper tooth contact is made between mainshaft gears seeking to center on the mainshaft during torque transfer and mating countershaft gears that distribute the load evenly. If not properly timed, serious damage to the transmission is likely to result from unequal tooth contact causing the mainshaft gears to climb out of equilibrium.

Timing is a simple procedure of marking the appropriate teeth of a gear set prior to installation and placing them in proper mesh while in the transmission. In the front section, it is necessary to time only the drive gear set. And depending on the model, only the LO range, deep reduction, or splitter gear set is timed in the auxiliary section.

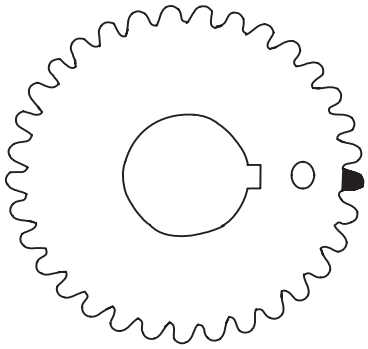


Figure 2

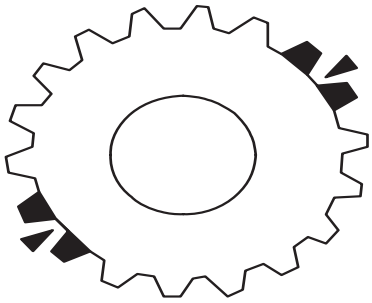
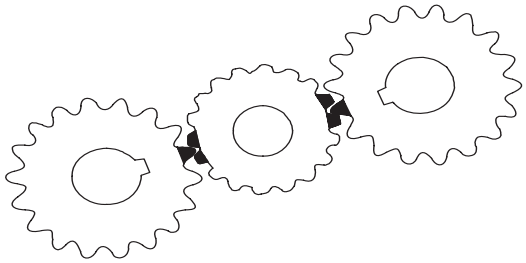


Figure 3



Procedure - Front Section

1. **Marking countershaft drive gear teeth:** Prior to placing each countershaft assembly into the case, clearly mark the tooth located directly over the drive gear keyway as shown. This tooth is stamped with an "O" to aid identification.

2. **Marking main drive gear teeth**: Mark any two adjacent teeth on the main drive gear.

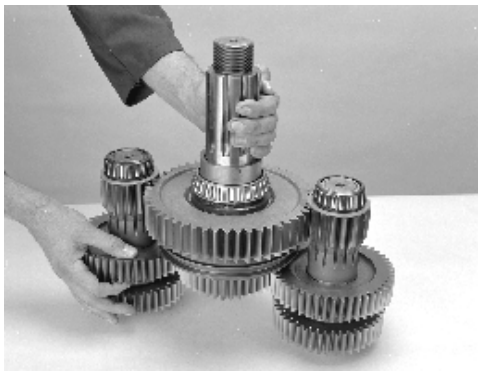
   Mark the two adjacent teeth located directly opposite the first set marked on the main drive gear. As shown to the left, there should be an equal number of unmarked gear teeth on each side between the marked sets.

3. **Meshing marked countershaft drive gear teeth with marked main drive gear teeth:** After placing the mainshaft assembly into the case, the countershaft bearings are installed to complete installation of the countershaft assemblies.

   When installing the bearings on the left countershaft, mesh the countershaft drive gear marked tooth with either set of main drive gear two marked teeth.

   Repeat the procedure when installing the bearings on the right countershaft, make use of the remaining set of main drive gear two marked teeth to time assembly.

Procedure - Auxiliary Section



1. **Marking the standard auxiliary countershafts:** Mark any two teeth on the LO range gear. Then mark two teeth located directly opposite the first marked.

   Prior to placing each auxiliary countershaft assembly into housing, mark the tooth on each auxiliary countershaft assembly LO range gear stamped with the "O".

   Follow the assembly procedures in the "Auxiliary Section".

2. **Marking the helical auxiliary countershafts:** Mark any two teeth on the LO range gear. Then mark two teeth located directly opposite the first marked.

   Prior to placing each auxiliary countershaft assembly into housing, mark the tooth on each auxiliary countershaft assembly LO range gear stamped with the two "O"s. Repeat the procedure on each auxiliary countershaft reduction gear.

   Follow the assembly procedures in the "Auxiliary Section".

How to Remove Oil Filter Adapter

Special Instructions

The Oil Filter Adapter **must** be removed before the transmission can be set on the table for servicing. Failure to do so will make the transmission unstable and may damage the filter adapter.

If the transmission is not equipped with an oil filter adapter at the pump outlet, skip this procedure.

Special Tools

- Typical service tools

Procedure -

1. Remove the oil filter by turning it in the counter-clockwise direction.

2. From the oil filter adapter, remove the (5) 3/16” allen head capscrews.

3. Remove the gasket and clean all mounting surfaces.

How to Assemble Oil Filter Adapter

Special Instructions

None

Special Tools

- Typical service tools

Procedure -

1. Position the new gasket on the adapter mounting surface with (2) capscrews through the adapter to hold the gasket in place.

2. Install the filter adapter and torque all capscrews to 8–12 lb-ft (10.85-16.30 N•m).

3. Install a new oil filter Eaton® Part # 4304827 or equivalent.

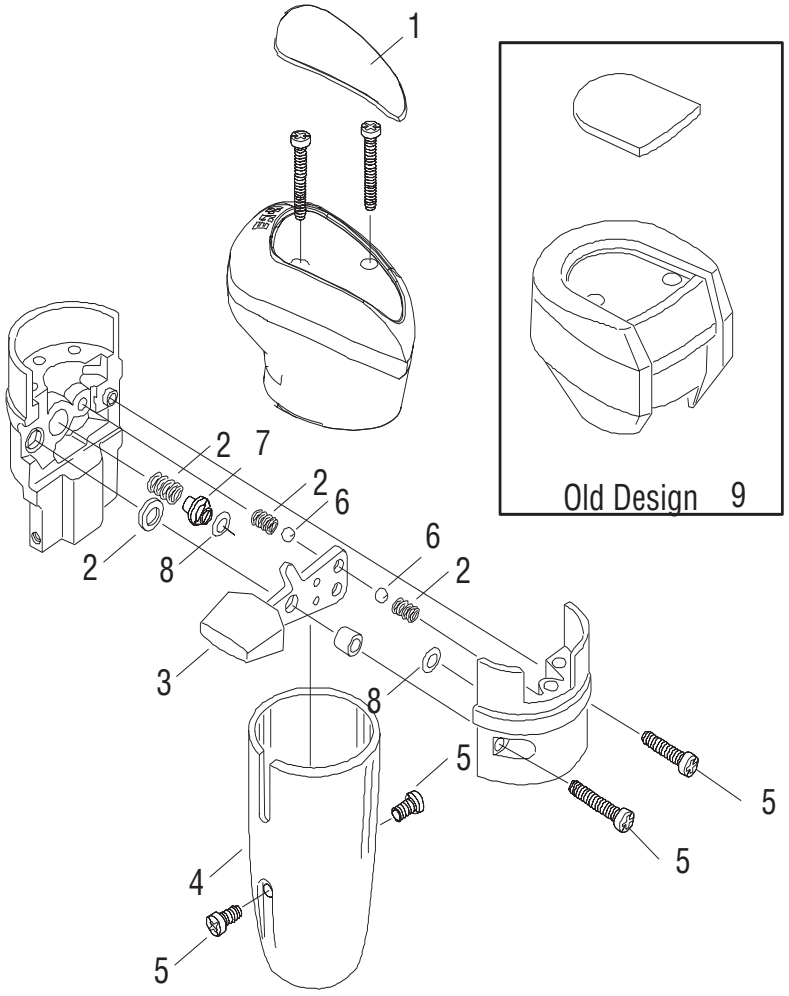
How to Disassemble Roadranger Valve A-5010

Special Instructions

None

Special Tools

- Typical service tools



Component Nomenclature and Auxiliary Countershaft Sectional View

1. Medallion
2. Spring
3. Lever
4. Cover
5. Screw
6. Ball 5/32”
7. Retainer
8. O-Ring
9. Old Style Shift Knob

Procedure -

1. Remove the two screws holding the bottom cover to the valve and slide the cover down the gearshift lever to expose air line fittings. Disconnect the air lines.

2. Loosen the jam nut and turn the Roadranger valve from the gear shift lever.

3. Pry the medallion from the recess in the top cover.

4. Turn out the two screws to remove the top cover from the valve housing.

5. Turn out the two screws in the side of the valve housing to separate the housing.

6. Remove the range selection lever from the left housing along with the position balls and guide.

7. If necessary, remove the spring and O-ring from the bores in the left housing.

8. If necessary, remove the springs, O-ring and sleeve from the bores in the right housing.

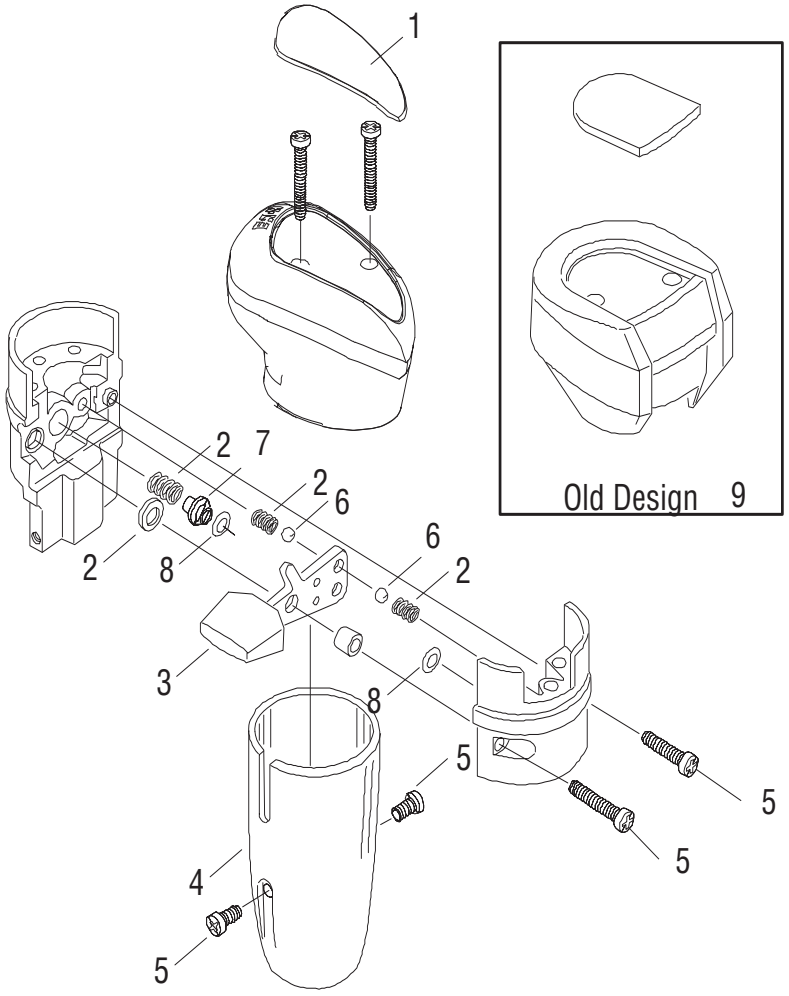
How to Assemble Roadranger Valve A-5010

Special Instructions

None

Special Tools

- Typical service tools



Component Nomenclature and Auxiliary Countershaft Sectional View

1. Medallion
2. Spring
3. Lever
4. Cover
5. Screw
6. Ball 5/32”
7. Retainer
8. O-Ring
9. Old Style Shift Knob

Procedure -

1. Refer to the drawing for proper reassembly. Use a very small amount of silicone lubricant on the O-rings to avoid clogging the ports. A small amount of grease on the position springs and balls will help to hold them in place during reassembly.

2. Reinstall Roadranger valve on gear shift lever and tighten the jam nut.

3. Attach the air lines and reinstall the bottom cover.

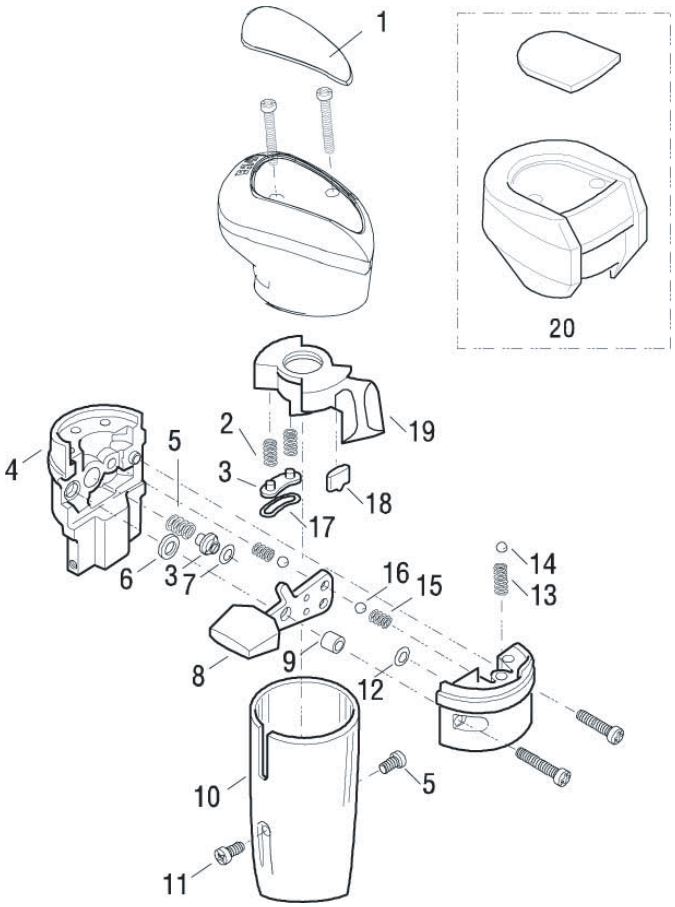
How to Disassemble Roadranger Valve A-4900

Special Instructions

None

Special Tools

- Typical service tools



Component Nomenclature and Auxiliary Countershaft Sectional View

1. Medallion
2. Spring
3. Retainer
4. Housing
5. Spring
6. Washer
7. O-Ring
8. Range Selector
9. Pin
10. Cover
11. Screw
12. O-Ring
13. Spring
14. 5/32” Ball
15. Spring
16. Ball
17. Seal
18. Detent
19. Splitter Button
20. Old Style Shift Knob

Procedure -

1. Remove the two screws holding the bottom cover to the valve and slide the cover down the gearshift lever to expose the air line fittings. Disconnect the air lines.

2. Loosen the jam nut and turn the control valve from the gear shift lever.

3. Pry the medallion from the recess in the top cover.

4. Turn out the two screws to remove the top cover from the valve housing.

5. Turn out the two screws in the side of the valve housing to separate the housing.

6. Remove the range selection lever from the left housing along with the position balls and guide.

7. If necessary, remove the spring and O-ring from the bores in the left housing.

8. If necessary, remove the springs, O-ring and sleeve from the bores in the right housing.

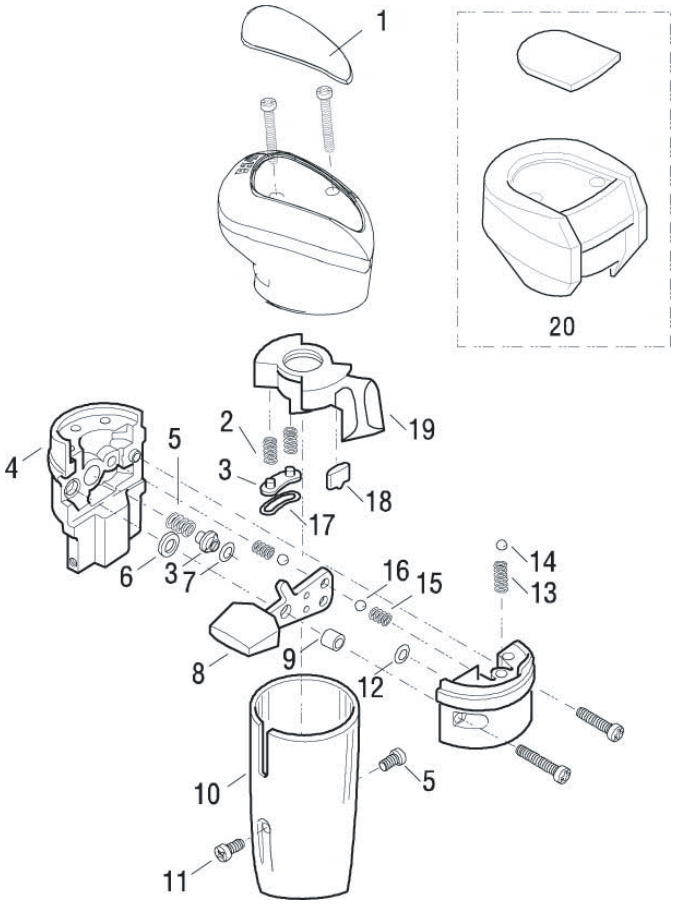
How to Assemble Roadranger Valve A-4900

Special Instructions

None

Special Tools

- Typical service tools



Component Nomenclature and Auxiliary Countershaft Sectional View

1. Medallion
2. Spring
3. Retainer
4. Housing
5. Spring
6. Washer
7. O-Ring
8. Range Selector
9. Pin
10. Cover
11. Screw
12. O-Ring
13. Spring
14. 5/32” Ball
15. Spring
16. Ball
17. Seal
18. Detent
19. Splitter Button
20. Old Style Shift Knob

Procedure -

1. Refer to the drawing for proper reassembly. Use a very small amount of silicone lubricant on the O-rings to avoid clogging the ports. A small amount of grease on the position springs and balls will help to hold them in place during reassembly

2. Install the control valve on the gear shift lever and tighten the jam nut.

3. Attach the air lines and install the bottom cover.

How to Install the Air Lines and Hoses

Special Instructions

Make sure air lines and hoses are not damaged.

Install the air lines and hoses at their proper location.

All externally threaded 1/8” or 5/32” air lines and pipe fittings that are not coated with pre-applied thread sealant must be coated with Eaton® sealing material #71209 or equivalent for at least 5 complete and consecutive threads.

All externally threaded 1/4” air fittings that are not coated with pre-applied thread sealant must be coated with Eaton sealing material #71209 or equivalent for at least 3 complete and consecutive threads.

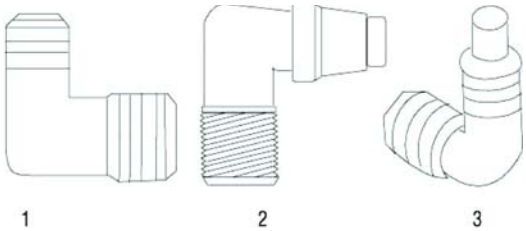
For the 1/4” I.D. air hoses, install the fixed nut end first.

To install the air lines and hoses, the air filter/regulator must be in position.

If you are unsure of the air lines and hose location, see the Air System Troubleshooting Guide TRTS0920.

Special Tools

- Typical service tools
- For 'push-to-connect' fittings, the Eaton service tool kit K-2394 is recommended. The kit contains the release tool and a tubing cutter.



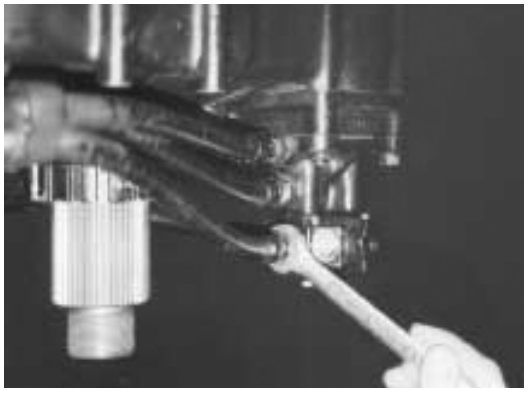
Air Line Fitting Types

1. 1/8" tube-1/8" NPTF
2. Push-to-connect
3. 5/32" tube-1/8" NPTF

Procedure -

1. Replace damaged air fittings.

2. Connect the air lines from the slave valve to the range cylinder.



3. Connect all removed air lines and hoses.

4. Make sure the fittings are tight and the lines are not kinked.

How to Remove Compression Type Fittings

Special Instructions

⚠ WARNING

A sudden release of air pressure can cause personal injury or damage to equipment. To prevent injury or equipment damage, exhaust the vehicle air tanks

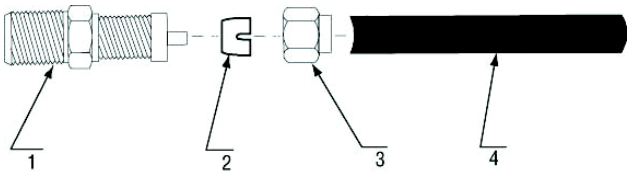
⚠ CAUTION

Small air lines are available in 1/8" or 5/32" sizes. Make sure 1/8" air lines are used with 1/8" fittings and 5/32" air lines are used with 5/32" fittings. Mixing sizes can cause air leaks or damage to fittings.

Before removing the air lines and hoses, label or record their location.

Special Tools

- Typical service tools



1. Connector
2. Collet
3. Nut
4. Air Line

Procedure -

1. Exhaust the vehicle air tanks before continuing.
2. Loosen the nut on the fitting, and slide it back out of the way.
3. Pull the air line and attached collet from the fitting.
4. Inspect the fitting, air line, collet, and nut for damage or wear. Replace as necessary.

How to Remove the Air Lines and Hoses

Special Instructions

Before removing the air lines and hoses, label or record their location.

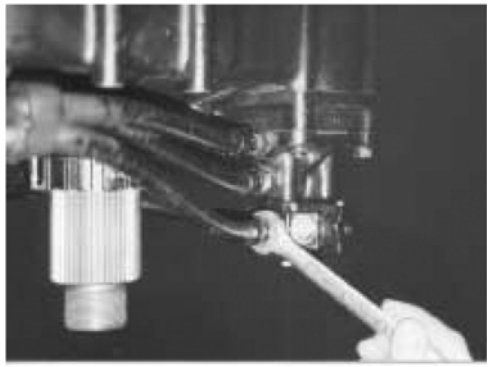
If you are unsure of their location, after you remove the air lines and hoses, see the Air System Troubleshooting Guide TRTS0920.

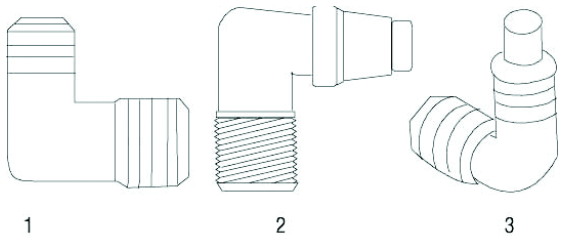
Special Tools

- Typical service tools
- For “push-to-connect” fittings, the Eaton service tool kit K-2394 is recommended. The kit contains the release tool and the tubing cutter.

Procedure -

1. Disconnect all air lines and hoses.
2. Inspect the air lines and hoses.





Air Line Fitting Types

1. 1/8" tube-1/8" NPTF
2. Push-to-connect
3. 5/32" tube-1/8" NPTF

3. Inspect air fittings and remove if damaged.

How to Install Compression Type Fittings

Special Instructions

⚠ WARNING

A sudden release of air pressure can cause personal injury or damage to equipment. To prevent injury or equipment damage, exhaust the vehicle air tanks

⚠ CAUTION

Small air lines are available in 1/8" or 5/32" sizes. Make sure 1/8" air lines are used with 1/8" fittings and 5/32" air lines are used with 5/32" fittings. Mixing sizes can cause air leaks or damage to fittings.

Special Tools

- Typical service tools

Procedure -

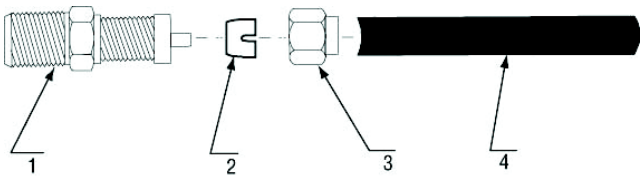
1. Check the threads of the fitting for thread sealant. If no sealant is present, apply Eaton thread sealant #71205 or equivalent.

2. Install the fitting.

   Note: Do not overtighten the nut. Overtightening can compress the collet too much and cause an air line restriction.

3. Install the air line, collet, and nut. If installing a new fitting, place the collet in the fitting and loosely install the nut. (Do not tighten the nut yet.) Insert the air line through the nut and into the collet. Tighten the nut as usual.

4. Enable the vehicle air system. Allow the air tanks to pressurize, and check for leaks. Repair as necessary.



1. Connector
2. Collet
3. Nut
4. Air Line

How to Remove Push-To-Connect Type Fittings

Special Instructions

⚠ WARNING

A sudden release of air pressure can cause personal injury or damage to equipment. To prevent injury or equipment damage, exhaust the vehicle air tank.

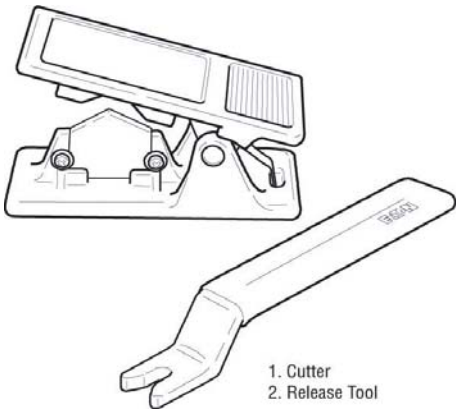
⚠ CAUTION

Make sure only 5/32" air lines are used with push-to-connect fittings. Using sizes other than 5/32" can cause air leaks or damage to fittings.

Before removing the air lines and hose, label or record their location.

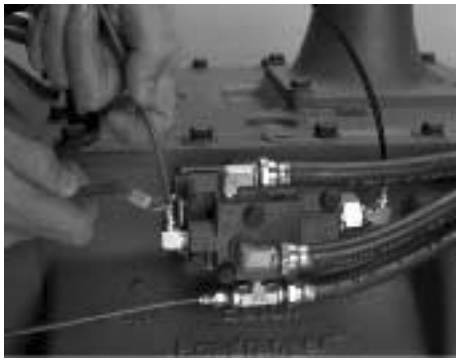
Special Tools

- See Tool Information (see Table 8)
- For "push-to-connect" fittings, the Eaton service tool kit K-2394 is recommended. The kit contains the release tool and the tubing cutter.



Procedure -

1. Exhaust the vehicle air tanks before continuing.



2. Use the air line release tool from kit K-2394 to press the release sleeve down while pulling the air line from the fitting.
3. Inspect the fitting for damage or wear. Remove and replace as necessary.

How to Install Push-To-Connect Type Fittings

Special Instructions

⚠ WARNING

A sudden release of air pressure can cause personal injury or damage to equipment. To prevent injury or equipment damage, exhaust the vehicle air tanks

⚠ CAUTION

Make sure only 5/32" air lines are used with push-to-connect fittings. Using sizes other than 5/32" can cause air leaks or damage to fittings

Special Tools

- See Tool Information (see Table 5)
- For 'push-to-connect' fittings, we recommend Eaton service tool kit K-2394. The kit contains the release tool and the tubing cutter.

Procedure -

1. Check the threads of the fitting for thread sealant. If no sealant is present, apply Eaton thread sealant #71205 or equivalent.
2. Install the fitting.
3. Inspect the air line for burrs or deformed areas. Trim the air line if necessary using a sharp razor blade or the air line cutting tool from kit K-2394. The cut must be smooth and square. If the tubing end is deformed or burred, the internal o-ring in the fitting will be damaged when the air line is inserted.
4. Push the air line into the fitting. It should insert approximately 3/4". If it does not insert far enough or is difficult to insert, the fitting may be damaged and should be replaced. After inserting, give the air line a slight tug to make sure the line stays in place. If line does not stay in place, replace the fitting.
5. Enable the vehicle air system. Allow the air tanks to pressurize, and check for leaks.

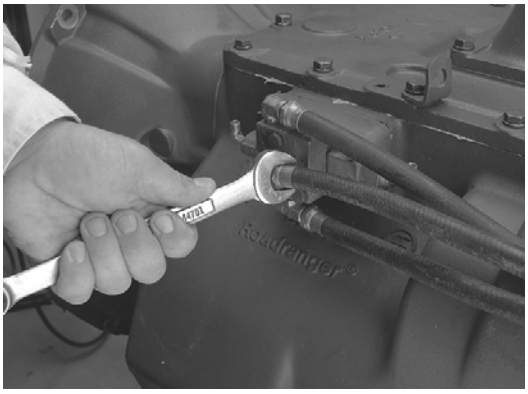
How to Remove Rubber 1/4" Air Hoses

Special Instructions

For the 1/4" I.D. air hoses, install the fixed nut end first.

Special Tools

- Typical service tools



Procedure -

1. Remove all air line brackets and ties.
2. Remove swivel end.
3. Remove fixed end.

How to Remove the Air Filter/Regulator

Special Instructions

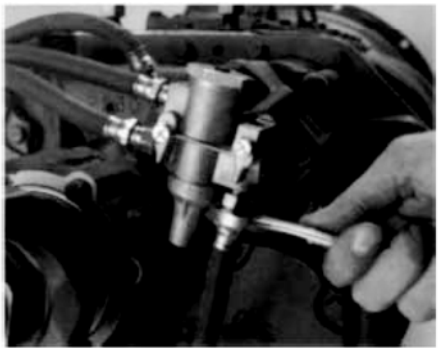
The air filter/regulator has two (2) O-rings located between the filter/regulator and the auxiliary section.

Special Tools

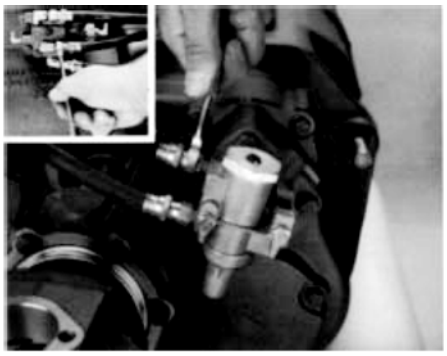
- Typical service tools

Procedure -

1. Disconnect and remove the 1/4" I.D. air line between the splitter cylinder and air filter/regulator.



2. Disconnect and remove the 1/4" I.D. air hoses between the slave valve and both the air filter/regulator and range cylinder assembly.



3. Turn out the two capscrews and remove the air filter/regulator assembly.

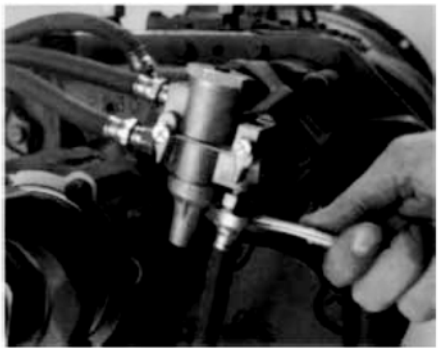
How to Install the Air Filter/Regulator

Special Instructions

The air filter/regulator has two (2) O-rings located between the filter/regulator and the range cylinder cover.

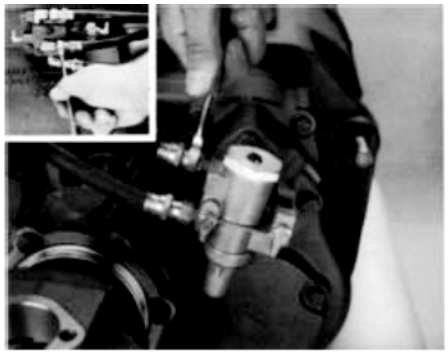
Special Tools

- Typical service tools



Procedure -

1. Position the air filter/regulator.
2. Apply Eaton/Fuller Sealant #71205 or equivalent to the two (2) retaining capscrews.
3. Install the two (2) retaining capscrews, tighten to 8-12 Lb•ft. of torque.



4. Install the 1/4" I.D. air hoses between the slave valve and both the air filter/regulator and range cylinder assembly.

5. Install the 1/4" I.D. air line between splitter cylinder and air filter/regulator.

How to Remove a Roadranger Valve

Special Instructions

⚠ WARNING

A sudden release of air pressure can injure you or damage equipment. To prevent injury or equipment damage, the vehicle air tanks must be exhausted.

Special Tools

- Typical service tools

Procedure -

1. From the Roadranger valve cover, remove the two (2) mounting screws.
2. Slide the Roadranger valve cover down.

3. From the air fittings, disconnect the air lines.

4. From the Roadranger base, loosen the jam nut. Rotate the Roadranger valve until the valve is removed.
5. Inspect the parts: nut, valve cover, air lines, sheathing, and o-rings from the lever shaft.
6. In the Roadranger valve, inspect the air fittings, and remove if damaged.

How to Install a Roadranger Valve

Special Instructions

To position the Roadranger valve, the range lever must be to the front or the splitter button to the left when facing forward.

Special Tools

- Typical service tools

Procedure -

1. Make sure the nut, valve cover, air lines, sheathing, and o-rings are in position on the lever shaft.
2. If previously removed, replace the air fittings and torque to 84-120 lb-in (9.49-13.56 N•m).
3. Place the Roadranger valve on the lever shaft and rotate so the range selector faces the vehicle front.
4. From the Roadranger valve bottom, torque the jam nut to 35-45 lb-ft (47.45-61.01 N•m).

5. Connect the air lines to the air fittings.

6. Slide the cover into position on the Roadranger valve.
7. Install the Roadranger valve cover mounting screws.

   Note: Make sure the air lines are seated fully.

How to Install Rubber 1/4" Air Hoses

Special Instructions

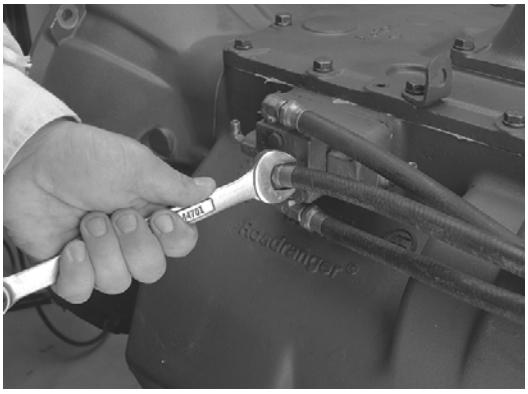
For the 1/4" I.D. air hoses, install the fixed nut end first.

Special Tools

- Typical service tools

Procedure -

1. If necessary, apply Eaton thread sealant #71205 or equivalent to threads.
2. Install and tighten fixed end first, then install and tighten swivel end.
3. Replace all air line brackets and ties.



How to Remove a Slave Valve

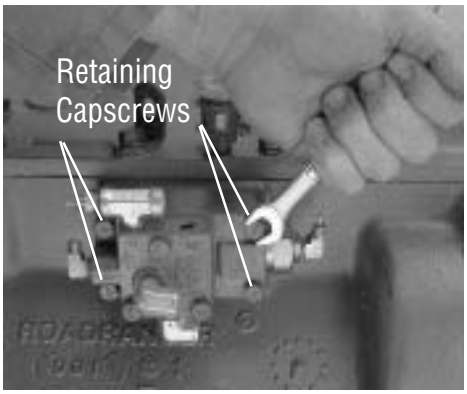
Special Instructions

⚠ WARNING

A sudden release of air pressure can injure you or damage equipment. To prevent injury or equipment damage, the vehicle air tanks must be exhausted.

Special Tools

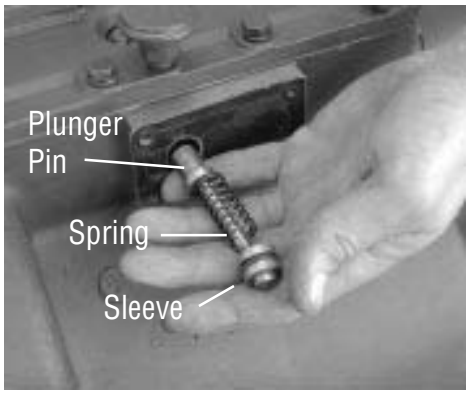
- Typical service tools



Procedure -

1. Record or mark air line locations.
2. Remove all air lines.

   Note: Remove three 1/4" ID air hoses at swivel fitting at range cylinder location. Remove air line bracket at rear of transmission. Remove slave valve with air hoses still attached.
3. Remove the retaining capscrews around valve perimeter.



4. Remove slave valve and gasket.
5. From the transmission case, remove the sleeve, spring, and plunger pin.

6. Inspect the air fittings, replace if damaged.

How to Install a Slave Valve

Special Instructions

None

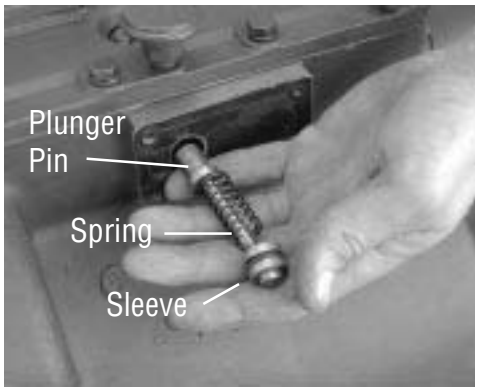
Special Tools

- Typical service tools

Procedure -

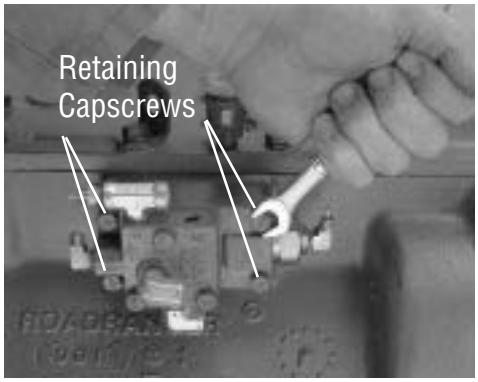
1. Clean gasket surface and install air fittings.

2. Lightly lubricate and install plunger pin, spring, and sleeve into case.



3. Install any necessary air hoses at this time.
4. Install new gasket.
5. Apply Eaton sealant #71205 or equivalent to the retaining capscrews.
6. Install the retaining capscrews, torque to 8-12 lb-ft (10.85-16.30 N•m).

   Note: Make sure the retaining capscrews are properly torqued.



How to Remove the Gear Shift Lever/Remote Shift Control

Special Instructions

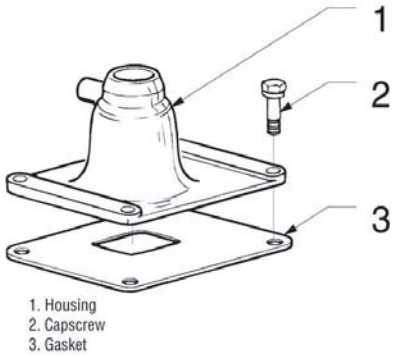
The air lines must be disconnected from the transmission or from the Roadranger valve.

Different detent springs are available to increase or decrease shifting effort. Note and record specific locations for specific springs. In some cases, a stiffer spring is installed in the top rail position.

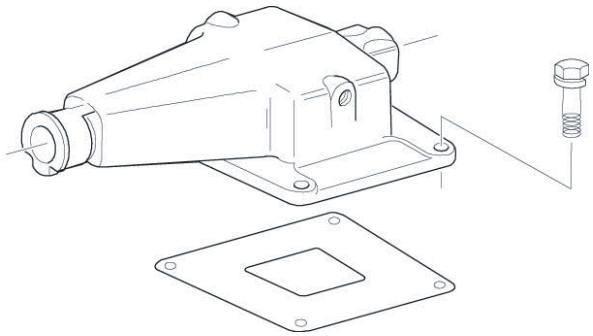
Remote control housings are removed the same way as gear shift levers.

Special Tools

- Typical service tools



1. Housing
2. Capscrew
3. Gasket



Procedure -

1. From the gear shift lever base/shift control housing, remove the four (4) retaining capscrews.

2. To break the gasket seal, lightly jar the gear shift/shift control housing.

3. Remove the gear shift lever housing.

   ⚠ CAUTION

   Make sure the detent springs do not fall into the transmission.

4. Remove detent springs as needed.

5. Remove the gasket and clean the area the replacement gasket will contact.

How to Install the Gear Shift Lever/Remote Shift Control

Special Instructions

Remote control housings are installed the same way as gear shift levers.

For standard and forward shift bar housings, make sure the detent springs and balls are in the shift bar housing top bores.

Make sure the shift block and yoke notches are aligned in the neutral position.

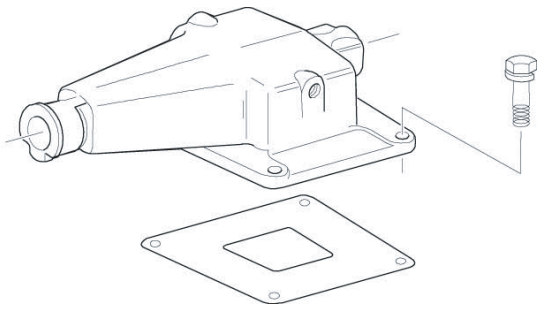
Special Tools

- Typical service tools

Procedure -

1. Thoroughly clean mounting surface.
2. Position a new gear shift lever/shift control housing gasket on the gear shift lever mounting surface.
3. Install the detent springs.

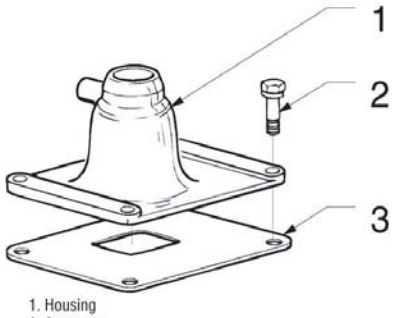
4. Install the shift lever/shift control housing. Make sure the tip (finger) of the gear shift lever fits into the slots in the shift block.



5. Apply Eaton sealant #71205 or equivalent to the retaining capscrews.
6. Install the retaining capscrews, torque to 35-45 lb-ft (47.45-61.01 N•m).

   Note: Make sure the capscrews are properly torqued.

   Note: Make sure you can shift the transmission.



1. Housing
2. Capscrew
3. Gasket

How to Adjust the Remote Shift Control (LRC Type)

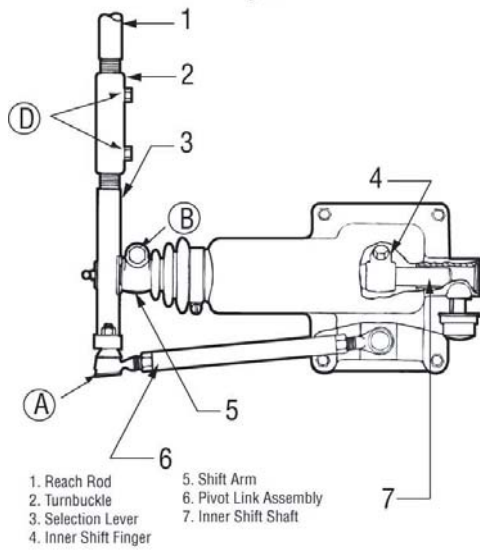
Special Instructions

The following is a typical adjustment procedure for an LRC type slave control. It is recommended that the OEM Chassis Service Manual be consulted first.

Special Tools

- Typical service tools

Figure A



Procedure -

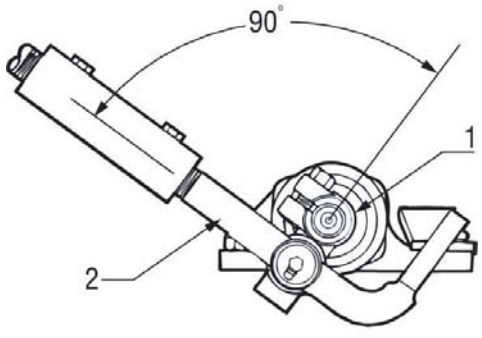
1. Move the gear shift lever forward or backward to the neutral position.

2. Move the gear shift lever sideways, toward reverse, until you feel resistance from the reverse plunger spring. DO NOT shift to reverse. The shift finger must remain in this position while you are making all the adjustments.

3. Remove the cotter pin, castle nut and ball joint A (see figure A) from the selection lever. Do not remove the ball joint from the pivot link.

4. Loosen the capscrew B (see figure A) and remove the shift arm from the inner shift shaft. Do not disconnect the selection lever from the shift arm.

Figure B



5. Turn the shift arm until it is at a right angle (90°) to the selection lever as viewed from the side (see figure B).

   Note: Ideally, the shift arm should be adjusted 90° to the selection lever as described, but in some chassis configurations it may be necessary to index the shift arm in the vertical position. Indexing the shift lever is done to prevent shift lever jump out. This type of adjustment will cause an unequal amount of gear shift lever travel between neutral and a forward lever position as compared to neutral and a rearward lever position.

6. Install the shift arm on the splines of the inner shift shaft. You may have to move the shift arm 4° or 5° to align the splines of the two parts. Disregard any movement of the gear shift lever at this point. The gear shift lever will be adjusted later.

7. Tighten the capscrew B (see figure A) on the shift arm.

8. Connect the pivot link assembly ball joint to the selection lever. Secure it with the castle nut and cotter pin.

9. Loosen the jam nuts C (see figure C) on the pivot link.

10. Check to be sure the inner shift finger is still in place.

11. Rotate the pivot link until the curved end of the selection lever is parallel with the shift arm as viewed from the rear (see figure C).

12. Tighten the pivot link jam nuts C (see figure C).

13. Loosen both capscrews on the turnbuckle D (see figure A).

14. Check to be sure inner shift finger is still in place.

15. Rotate the turnbuckle to obtain the proper forward-backward neutral position of the gear shift lever in the cab.

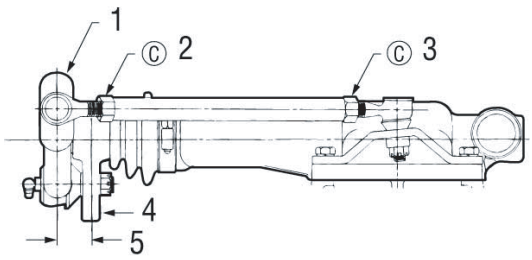
16. Tighten one turnbuckle D capscrew (see figure A).

17. Move the gear shift lever to the desired position.

18. Turn the second turnbuckle D capscrew.

19. Check for linkage obstructions in all gear positions.

Figure C



1. Selection Lever
2. (L.H. Thread)
3. (R.H. Thread)
4. Shift Arm
5. Parallel

Neutral Switch Operation and Testing

Special Instructions

The neutral switch is a normally closed switch. An electrical current flows through it when the transmission shifter is in the neutral position. When the transmission shifter is in gear, the switch is open and no current flows through it. Likewise, the switch is open when the ball is depressed. The switch is actuated by the air valve shaft.

Special Tools

- Typical service tools
- Volt/Ohm meter

Procedure -

1. Disconnect the wiring from the switch.

2. Connect an ohm meter to check for continuity or a small reading.

3. Place the transmission shift lever in the neutral position. The ohm meter should register continuity or a small reading. If it does, go to the next step. If it does not, remove the switch and replace it.

4. Shift the transmission into all gear positions. The ohm meter should read open or infinity. If it does not, remove the switch. Then, depress the switch ball and check for continuity. The ohm meter should read open or infinity when the ball is depressed.

5. Look into the neutral switch hole and verify that the air valve shaft moves as the transmission is shifted from neutral into gear.
   a. If it does, replace the switch.
   b. If not, remove the shift bar housing and check the air valve and shift rails for excessive wear. Also, check the slave valve plunger and spring for free movement.

How to Remove the Neutral Switch

Special Instructions

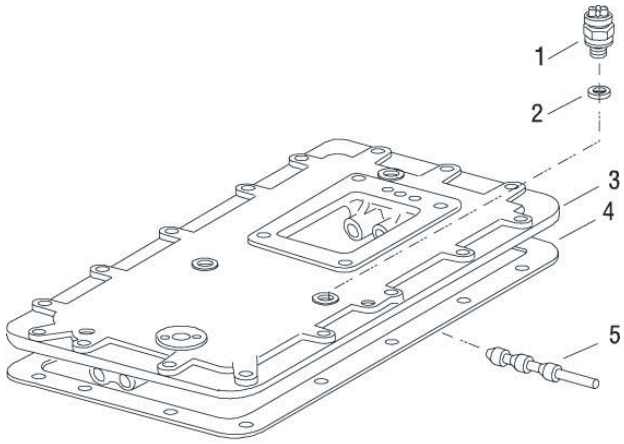
None

Special Tools

- Typical service tools

Procedure -

1. Remove 2 screws retaining wire terminals.
2. Remove the switch using a 7/8" deep well socket or box end wrench.



1. Neutral Light Switch
2. Gasket
3. Shift Bar Housing
4. Gasket
5. Air Valve Shaft

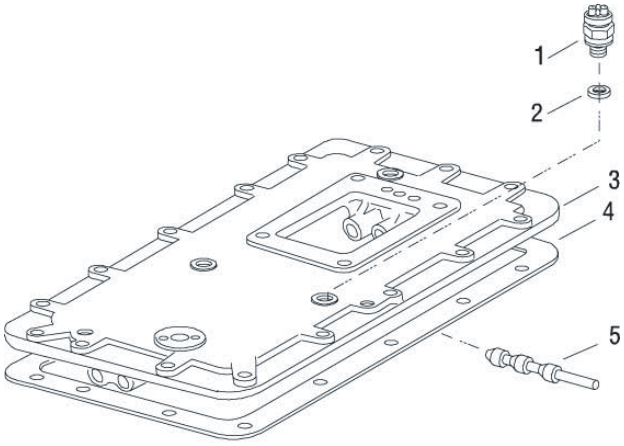
How to Install the Neutral Switch

Special Instructions

None

Special Tools

- Typical service tools



1. Neutral Light Switch
2. Gasket
3. Shift Bar Housing
4. Gasket
5. Air Valve Shaft

Procedure -

1. Install a new gasket.
2. Install the neutral switch, torque to 15-20 lb-ft (20.34-27.12 N•m).
3. Connect the wiring to the switch.

Reverse Switch Operation and Testing

Special Instructions

The reverse switch is a normally open ball switch. When the transmission is shifted into reverse, a ramp on the reverse yoke bar contacts and raises a pin. The pin depresses the ball on the switch, which closes the switch contact, allowing current to flow through the switch and light up the vehicle's backup lights.

Special Tools

- Typical service tools
- Volt/Ohm meter

Procedure -

1. Disconnect the wiring from the switch.

2. Connect an ohm meter to check for continuity.

3. Place the transmission shift lever in any position except reverse. If the switch is working properly, the ohm meter should read open or infinity. If it is not, remove the switch and recheck it for continuity. Replace as necessary.

4. Place the transmission shift lever in the reverse position. If the switch is working properly, the ohm meter should register continuity, or a small reading. If it does not, remove the switch and recheck it for continuity. Replace it as necessary. Also, check for sticking or excessive wear of the reverse pin.

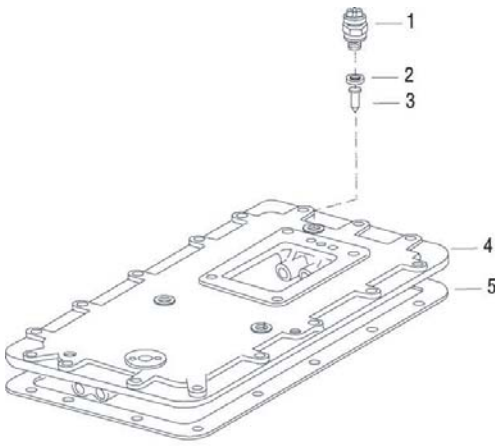
How to Remove the Reverse Switch

Special Instructions

None

Special Tools

- Typical service tools



1. Reverse Light Switch
2. Gasket
3. Pin
4. Shift Bar Housing
5. Gasket

Procedure -

1. Remove 2 screws retaining wire terminals.
2. Remove the switch using a 7/8" deep well socket or box end wrench.

How to Install the Reverse Switch

Special Instructions

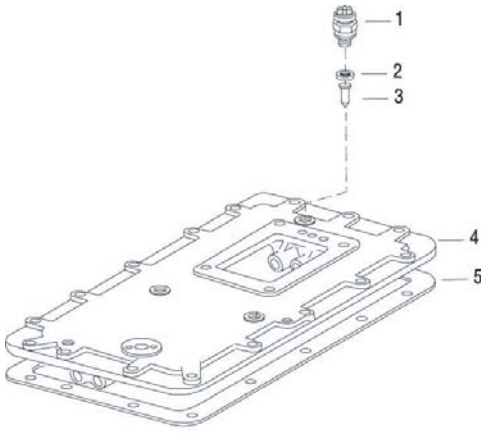
None

Special Tools

- Typical service tools

Procedure -

1. Insert the reverse pin in the reverse switch bore.
2. Install new gasket on switch.
3. Install the reverse switch, torque to 15-20 lb-ft (20.34-27.12 N•m).
4. Connect the wiring to the switch.



1. Reverse Light Switch
2. Gasket
3. Pin
4. Shift Bar Housing
5. Gasket

How to Remove the Shift Bar Housing

Special Instructions

CAUTION: Always wear eye protection when using compressed air.

Special Tools

- Typical service tools

Procedure -

1. Use compressed air to clean any loose dirt or debris from transmission top.

2. Remove the four capscrews from the shift control and secure to the side or remove completely. It may be necessary to label and disconnect the small air lines from the slave valve.

3. Label and disconnect all wiring for reverse and neutral switches.

4. Remove the capscrews from around the shift bar housing top. Note location of the lifting eyes, longer capscrews and any studs.

5. If necessary, use a hammer to break the gasket seal. Lift the shift bar housing from the transmission top.

How to Install the Shift Bar Housing

Special Instructions

None

Special Tools

- Typical service tools

Procedure -

1. Make sure the gasket surfaces are clean and free of burrs or other damage.

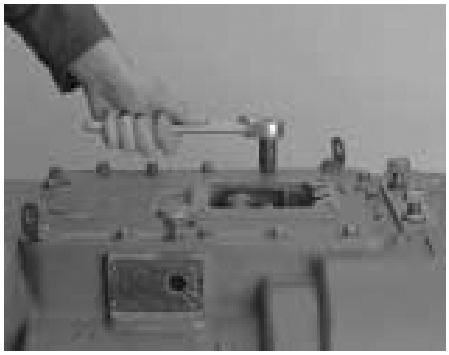
2. Use a gasket adhesive to attach the shift bar housing gasket to the flange surface on the shift bar housing bottom.

3. Make sure the sliding clutches in the transmission are centered in the neutral position.

4. Position the shift yokes in the neutral position and carefully lower the shift bar housing onto the transmission top. Make sure the shift yokes fit into the corresponding sliding clutches slots.

5. Just before the shift bar housing contacts the main case flange surface, it is necessary to move the shift bar housing slightly away from the slave valve to clear the slave valve plunger pin. Once the housing is flush with the main case, it can be repositioned to line up the capscrew holes.

   Note: Make sure the shift bar housing sits flush on the main case flange surface. If a gap is present, the shift bar housing may be caught on the slave valve plunger pin. Slide the shift bar housing to the side to clear the pin. Do not install and tighten the capscrews to draw the housing down, transmission damage will occur.



6. Apply sealer to capscrews and install the capscrews in their specific location. Tighten to 35-45 Lb·ft. Make sure the longer capscrews are used with the lifting eyes.

7. Install a new gasket for the shift control.

8. Install the shift control. Make sure the shift control finger properly enters the shift yoke and block notches.

9. Apply sealer to the capscrews and install. Tighten to 35-45 Lb·ft.

10. Connect the wiring for the reverse and neutral switches.

11. Connect the small air lines to the previously marked locations.

How to Remove the Oil Seal - Mechanical Speedometer

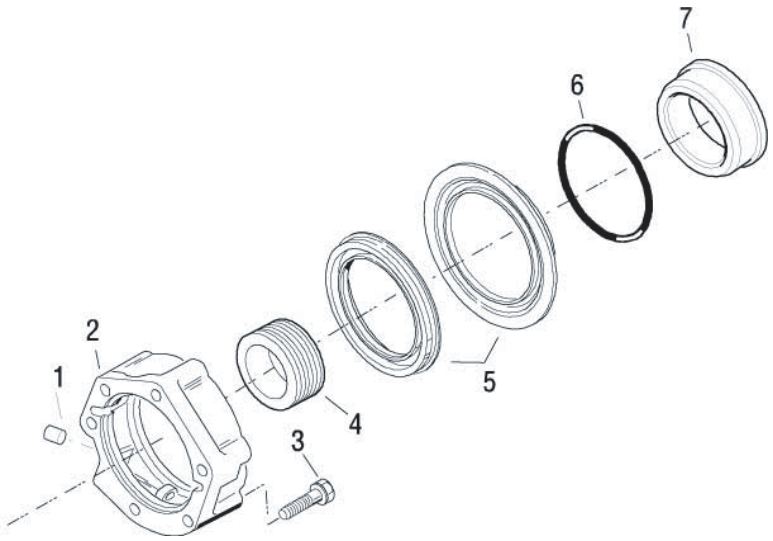
Special Instructions

Prior to replacing the seal, carefully inspect the transmission to make sure the oil leakage is coming from the seal. Pay particular attention to the speedometer parts, the rear bearing cover gasket surfaces, rear countershaft bearing covers, and shift bar housing.

For additional information on rear seal service, refer to the Seal Maintenance Service Brochure TRSM0912.

Special Tools

- See Tool Information (see Table 5 and 6)
- Brass drift
- Item T1: Output yoke puller
- Item T15: Slide hammer



1. Bushing
2. Rear Bearing Cover Assembly
3. Capscrew
4. Speedometer Drive Gear
5. Oil Seal with Slinger
6. O-Ring
7. Speedometer Spacer Assembly

Procedure -

1. Disconnect the driveshaft and U-joint from the output yoke according to the OEM or driveshaft manufacturer's instructions.

2. Shift the transmission into 1st gear or low gear (Low Range) to prevent the output yoke from turning when you loosen the output yoke nut.

3. Remove the output yoke nut using a 70 mm or 2 3/4" socket. See “How to Remove Output Yoke/Companion Flange”.

4. Remove the output yoke. If necessary, use an output yoke puller.

5. Remove the seal sleeve.

6. Use a slide hammer with a hook attachment to remove the seal. Or remove output bearing cover and drive seal out from front side.

   Note: The seal will be damaged during removal and must be replaced.

7. Remove seal slinger from the output yoke using a brass drift and hammer.

8. Inspect all parts of the seal surface for wear, scratches, burrs, or other damage.

   Note: Replace the seal surface if it is worn or damaged. Do not attempt to salvage the seal mating surface with crocus cloth, filing, etc.

How to Install the Oil Seal - Mechanical Speedometer

Special Instructions

⚠ CAUTION

To prevent oil leaks, do not touch the seal lip, and make sure the seal driver is clean.

Special Tools

- See Tool Information (see Table 8)
- Oil seal driver
- Oil seal slinger driver

Procedure -

1. The seal will be damaged during removal and must be replaced.
2. Place a seal on the oil seal driver, and drive the new seal into the rear bearing cover.
3. Install the new slinger on the output yoke using a slinger driver.
4. Install the output yoke over the output shaft. The yoke should slide on when the splines are lined up. If it does not, clean the splines with solvent, and oil them lightly.
5. Inspect the output shaft nut for damage and wear. If the nylon locking material is damaged or excessively worn, use a new output nut.

   Note: The nylon locking material must in good condition so that nut does not loosen when the vehicle is in use.
6. Lightly oil the output shaft threads and the output nut threads. Install the nut, torque to 450-500 lb-ft (610.12-677.91 N•m).
7. Connect the driveshaft and U-joint according to the OEM or driveshaft manufacturer's instructions.

How to Remove the Oil Seal - Magnetic Speedometer

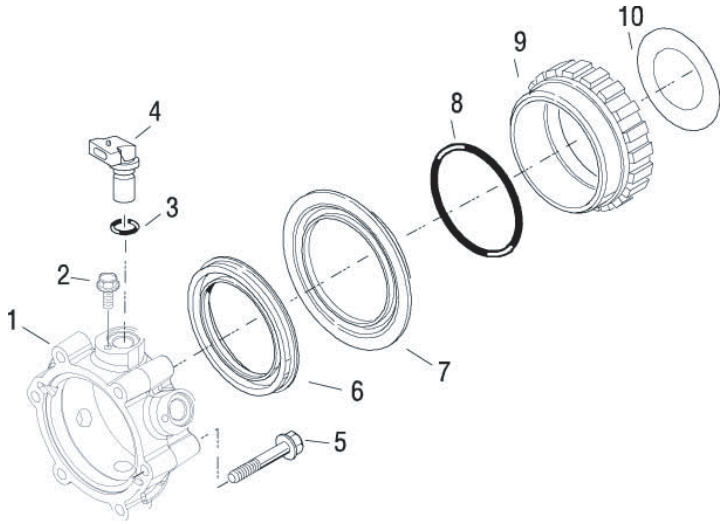
Special Instructions

Prior to replacing the seal, carefully inspect the transmission to make sure the oil leakage is coming from the seal. Pay particular attention to the speedometer parts, the rear bearing cover gasket surfaces, rear countershaft bearing covers, and shift bar housing.

For additional information on rear seal service, refer to the Rear Seal Maintenance Service Brochure TRSM0912.

Special Tools

- See Tool Information (see Table 6 Special Tools)
- Brass drift
- Item T1: Output yoke puller
- Item T15: Slide hammer



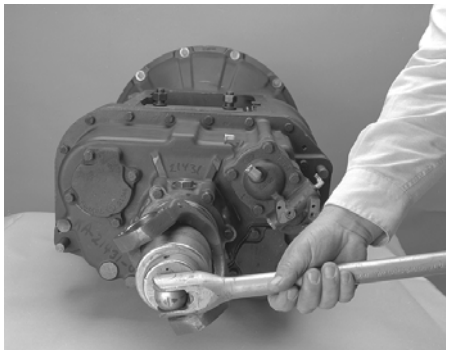
1. Rear Bearing Cover
2. Sensor Retaining Capscrew
3. O-Ring
4. Speedometer Sensor
5. Capscrew
6. Oil Seal
7. Slinger
8. O-Ring
9. Speedometer Spacer Assembly
10. Slinger

Procedure -

1. Disconnect the driveshaft and U-joint from the output yoke according to the OEM or driveshaft manufacturer's instructions.

2. Shift the transmission into 1st gear or low gear (Low Range) to prevent the output yoke from turning when you loosen the output yoke nut.

3. Remove the output yoke nut using a 70 mm or 2 3/4" socket.



4. Remove the output yoke. If necessary, use an output yoke puller. See “How to Remove the Output Yoke/Companion Flange.”

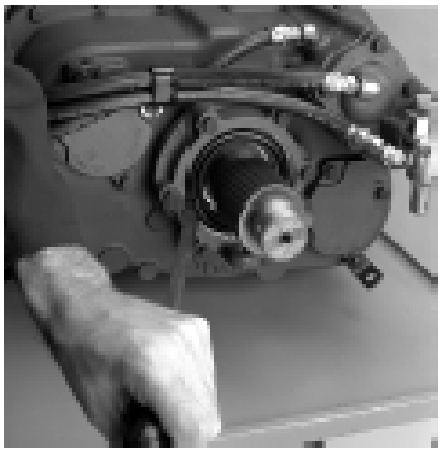
5. Remove the speedometer sensors from the rear bearing cover.

   Note: If the sensor is a thread in type, note the number of threads expose so the sensor can be reinstalled to the same depth. If the sensor is a push in type, remove the hold down capscrew and pull the sensor out of the bore.

6. Remove the speedometer rotor/seal sleeve and the o-ring.

7. Pry the seal out using a large screwdriver or prybar in the metal groove of the seal.

   Note: The seal will be damaged during removal and must be replaced.



8. Remove seal slinger from the speedometer rotor/seal sleeve using a brass drift and hammer.

9. Inspect all parts of the seal surface for wear, scratches, burrs, or other damage.

   Note: Replace the seal surface if it is worn or damaged. Do not attempt to salvage the seal mating surface with crocus cloth, filing, etc.

How to Install the Oil Seal - Magnetic Speedometer

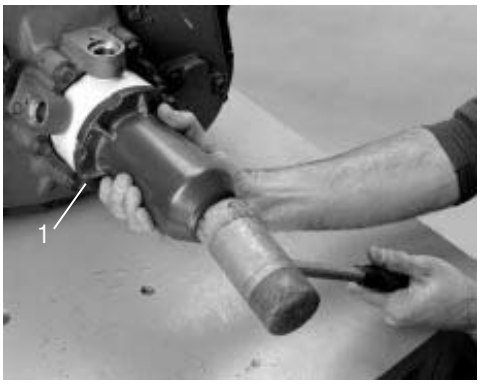
Special Instructions

⚠ CAUTION

To prevent oil leaks, do not touch the seal lip, and make sure the seal driver is clean.

Special Tools

- See Tool Information (see Table 8)
- Oil seal driver
- Oil seal slinger driver



Procedure -

1. Place a seal on the oil seal driver, and drive the new seal into the rear bearing cover. The seal is fully installed when the flange on the seal is flush with the shoulder in the bore.

2. Install the new slinger on speedometer rotor/seal sleeve using a slinger driver.

3. If previously removed, install the o-ring over the output shaft.

   Note: To avoid creating oil leaks, make sure the speedometer rotor/seal sleeve is free from contaminants.

4. Install the speedometer rotor/seal sleeve over the output shaft, and install the speedometer sensors.

5. Install the output yoke over the output shaft. The yoke should slide on an stop before contacting the speedometer rotor. As the output shaft nut is installed, the output yoke will contact the speedometer rotor.

6. Inspect the output shaft nut for damage and wear. If the nylon locking material is damaged or excessively worn, use a new output nut.

   Note: The nylon locking material must be in good condition so the nut does not loosen when the vehicle is in use.

7. Lightly oil the output shaft threads and output nut threads, and install the nut. Torque the nut to 450-500 lb-ft (610.12-677.91 N•m).

8. Connect the driveshaft and U-joint according to the OEM or driveshaft manufacturer's instructions.

How to Remove the Output Yoke/Companion Flange and Nut

Special Instructions

You must remove the shift bar housing in order to lock the transmission.

For proper cleaning and maintenance, see TRSM0912 "Rear Seal Maintenance Guide."

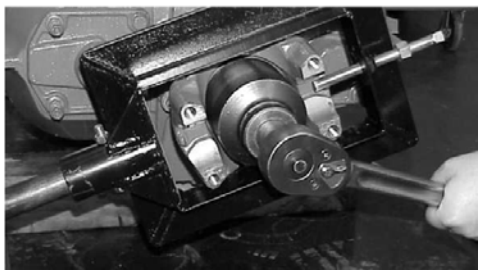
After removal of the output yoke/companion flange, temporarily replace the output shaft nut to protect the output shaft threads during auxiliary section disassembly.

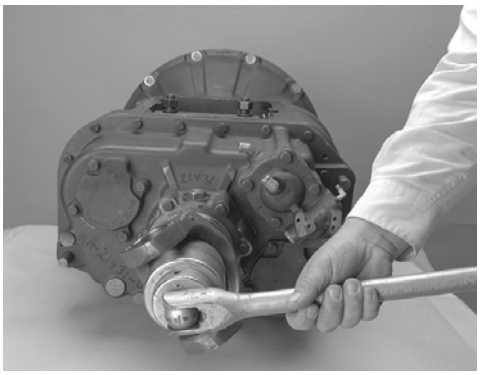
Special Tools

- See Tool Information (see Table 6 Special Tools)
- A large breaker bar or air impact wrench

Procedure -

1. Engage two (2) mainshaft sliding clutches into two (2) mainshaft gears to lock the transmission or use a yoke holding tool if available.





2. Use a large breaker bar or air impact wrench to remove the output shaft nut.

3. Remove the output yoke. Use the output yoke puller (Tool ref. ID T1).

How to Install the Output Yoke/Companion Flange and Nut

Special Instructions

You must remove the shift bar housing in order to lock the transmission.

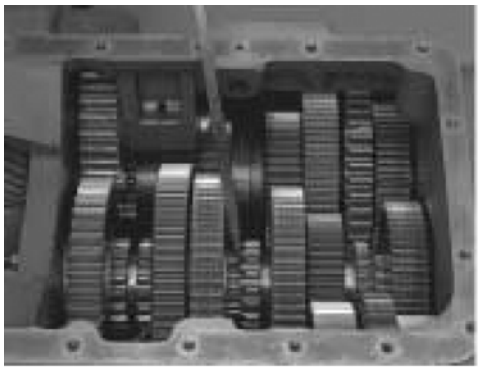
For proper cleaning and maintenance, see TCSM0912 Seal Maintenance Guide.

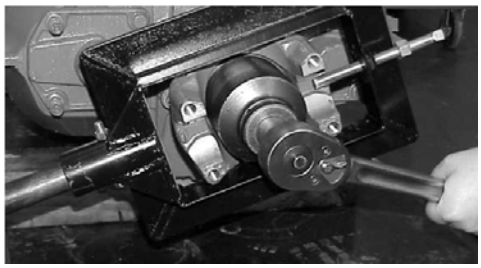
Special Tools

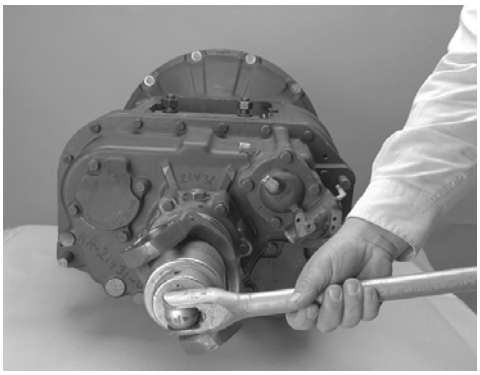
- Torque wrench with 0-600 lb-ft (0-813.49 N•m) capacity

Procedure -

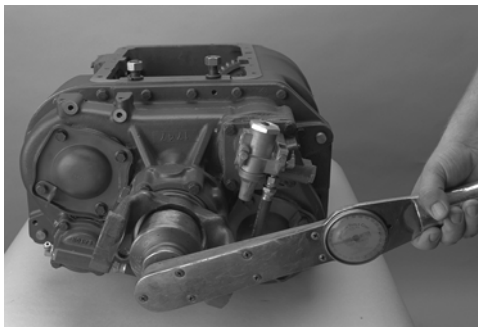
1. Engage two (2) mainshaft sliding clutches into two (2) mainshaft gears to lock the transmission, or use a yoke holding tool if available.
2. Install the speedometer drive gear rotor or replacement spacer on the output shaft inside the rear bearing cover.
3. If the slinger on the yoke is damaged, replace using a Slinger/Seal kit.







4. Install the output yoke over the output shaft. The yoke should slide on and stop before contacting the speedometer rotor. As the output shaft nut is installed, the output yoke will contact the speedometer rotor.



5. Install the output shaft nut, tighten to 450-500 lb-ft (610.12-677.91 N•m) of torque.

6. Make sure the output shaft nut is properly torqued and unlock the transmission, or remove the yoke holding tool.

How to Remove the Auxiliary Section in Chassis

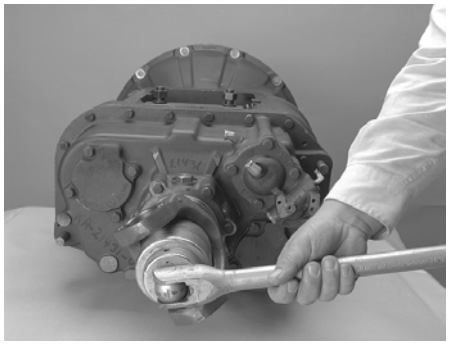
Special Instructions

None

Special Tools

- See Tool Information (see Table 6)
- Item T2: Auxiliary section hanger
- Item T14: Auxiliary section removal adapter plate
- A hoist with lifting chain

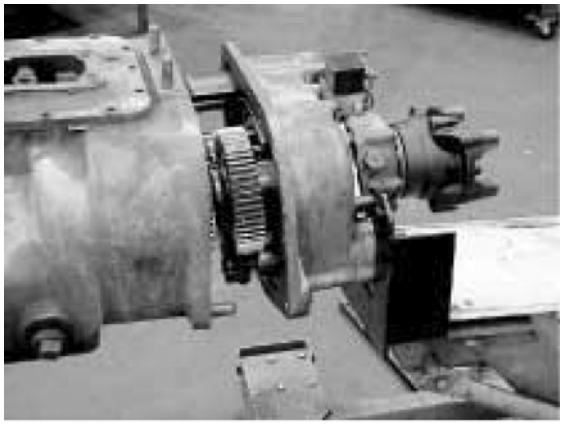
Procedure -

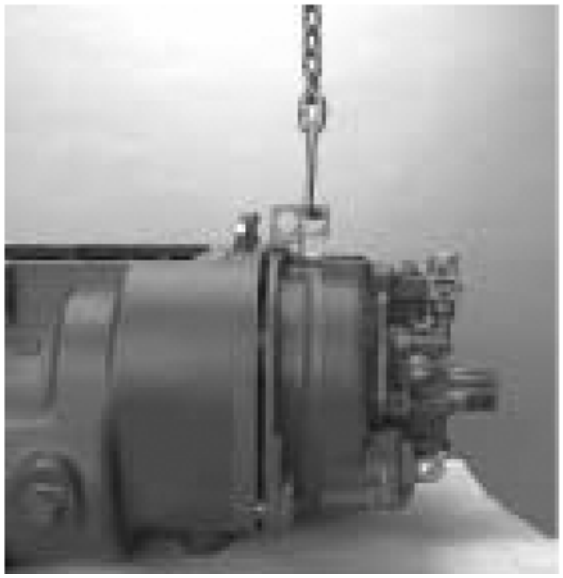


1. Drain the transmission oil.
2. Disconnect the driveshaft and U-joint from the output yoke.
3. If the auxiliary section is to be disassembled, remove the output nut. To prevent the output shaft from rotating while removing the nut, shift the transmission into 1st gear.
4. Disconnect the vehicle air supply line from the filter regulator assembly.
5. Mark the locations and disconnect the large rubber air lines. Move the lines aside.
6. Label and remove the small air lines.
7. Remove the four (4) capscrews and the auxiliary countershaft rear bearing cover, gasket, and rear bearing shim.
8. Install the auxiliary countershaft retaining straps with 2-3/8” NC x 1” and 1-3/8” NC x 1-1/2” clean capscrews.

   Note: Do not use and air gun. Tighten by hand until the capscrews are snug.

9. Drive the two dowel pins forward, and remove them.





10. Remove all but one capscrew that secure the auxiliary section to the main section. Leave one capscrew to secure the housing until it is ready to be removed.

    Note: Capscrews are different lengths. Note their locations for reassembly purposes.

    ⚠ WARNING

    Use the proper equipment with safety chains attached to remove the auxiliary section. The auxiliary section can slide rearward and could fall, causing you serious injury and/or damage to the auxiliary section.

11. Attach a chain and lifting device to the auxiliary section hanger (figure A), or attach the support jack to the auxiliary section (figure B).

12. With the support device in position, remove the remaining capscrew. If necessary, 3 capscrews can be installed into the three threaded holes in the auxiliary section flange. When threaded in they will push the auxiliary section rearward. Clean the holes of rust, paint, and other debris by threading a 3/8-16 tap into each hole. Thread each capscrew in evenly to prevent damage to the auxiliary housing.

    ⚠ CAUTION

    The weight of the auxiliary section must be supported during removal to avoid damage to internal transmission parts.

13. Support the weight of the auxiliary section with a lifting device or support jack and move the auxiliary section rearward until it is free from the front section of the transmission.

How to Install the Auxiliary Section in Chassis

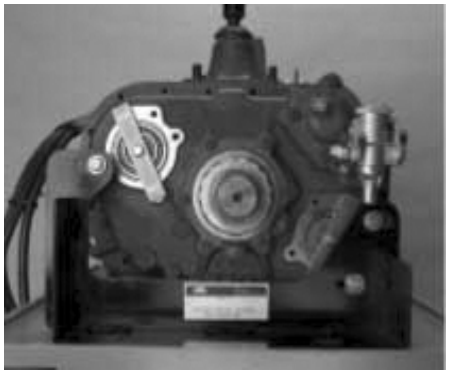
Special Instructions

None

Special Tools

- See Tool Information (see Table 6)
- Item T3: Countershaft support tools
- Item T14: Auxiliary section removal adapter plate
- A hoist with lifting chain

Procedure -



1. Install the countershaft support tools on the auxiliary section countershafts to center and hold the countershafts in position. Install a 3/8"-16 X 2 1/2" long capscrew into countershaft center.

2. If removed, slide the output yoke over the output shaft. Lightly oil the threads and install the output nut on the output shaft. Torque the nut to 450-500 lb-ft (610.12-677.91 N•m).

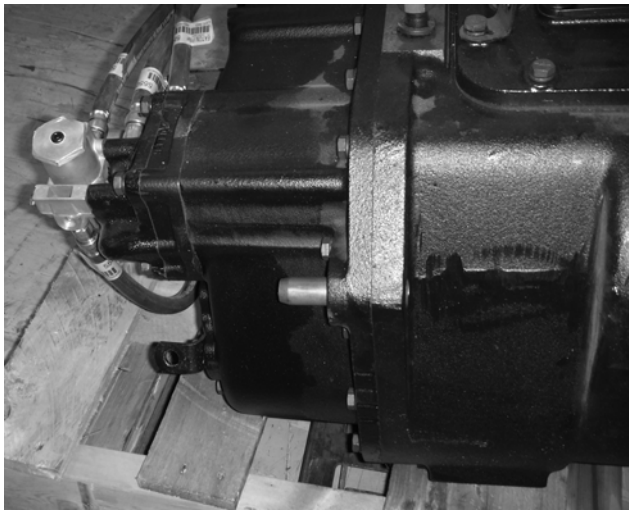
   Note: To prevent the output shaft from rotating while installing the nut, place a clean shop rag in the gear mesh.

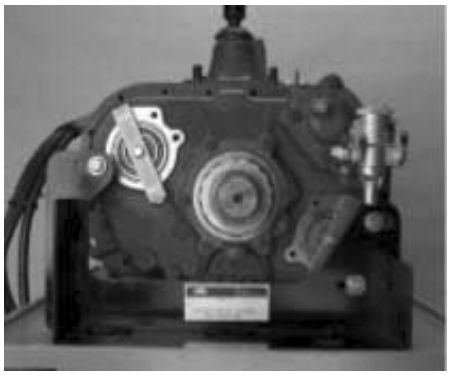
   Note: Due to chassis interference, it may not be possible to install the yoke at this step. However, the output shaft must be drawn fully into position to prevent it from sagging when the auxiliary section is installed in the chassis. If the chassis causes interference, the yoke can be temporarily installed to draw up the output shaft and then removed before the auxiliary section is installed.

3. Use crocus cloth or a wire wheel to clean rust and paint from the dowel pins before installing them.

   ⚠ CAUTION

   If the dowel pins are not installed in the main case to the proper depth, the auxiliary section will not properly align with the main case and bearing or synchronizer failure may occur.





4. Install the dowel pins into the main case so that 3/8"-1/2" of the shoulder is exposed or pin is flush with front of case ear.

5. Clean all rust and paint from the dowel pin holes in the auxiliary section housing, and lightly grease the dowel pins on the main case and the dowel pin holes on the auxiliary section housing.

6. Make sure the auxiliary section is in low range. If not, blow shop air (max 100 PSI) into the low range supply port to shift the range synchronizer to low. If necessary, make sure the deep reduction clutch is engaged into gear.

7. Position the gasket onto the main case mounting surface.

8. Mount the auxiliary section on the lifting device or jack.

9. Tighten the center capscrew on the countershaft support tools to draw the countershafts into a level position. Do not overtighten the capscrews. The output yoke and shaft must be able to rotate.

10. Position the auxiliary section in line with the main case, and slide the housing onto the dowel pins. Mesh the countershafts with the auxiliary drive gear. Rotate the output yoke and shaft slightly to help the gears mesh and slide the auxiliary section forward until it is flush with the main section.

⚠ CAUTION

The auxiliary section should slide into place fairly easily. DO NOT force it on or pull it into place with the capscrews. Excessive force may damage the transmission. If excessive force is necessary, the gearing is likely out of time.

11. If the auxiliary section does not install fully, slide it back and check the following:

    a. The output yoke and nut should be installed to pull back and center the auxiliary mainshaft assembly.

    b. The countershaft support tool center capscrew should be snug to level the countershafts.

    c. The dowel pins and auxiliary housing mating holes should be clean and well oiled.

    d. The internal gearing on the auxiliary section must have been properly timed during reassembly.

12. Apply Eaton® thread sealant #71205 or equivalent to the all the retaining capscrew threads. Install the capscrews to secure the auxiliary section to the main case, torque to 40-45 lb-ft (54.23-61.01 N•m).

13. If the countershaft, countershaft bearings, or auxiliary housing have been replaced, or if the countershafts, bearings, or shims were not marked and reassembled in the same location, the bearing endplay must be checked and set by shimming. Shim the countershaft bearings using "Shim Procedure without a Shim Tool".

14. If shimming is not required, remove the support tools, and install the proper shim, gasket, and countershaft bearing cover. Secure the bearing covers with the capscrews. Install sealer. Apply Loctite 242 to capscrew threads and torque to 40-45 lb-ft (54.23-61.01 N•m).

15. Connect all removed air hoses and lines. Use Eaton® Fuller® thread sealant #71205 or equivalent as necessary.

16. Connect the driveshaft and U-joint, and refill the transmission with the recommended lubricant. For lubrication instructions refer to the "Lubrication and Maintenance" section.

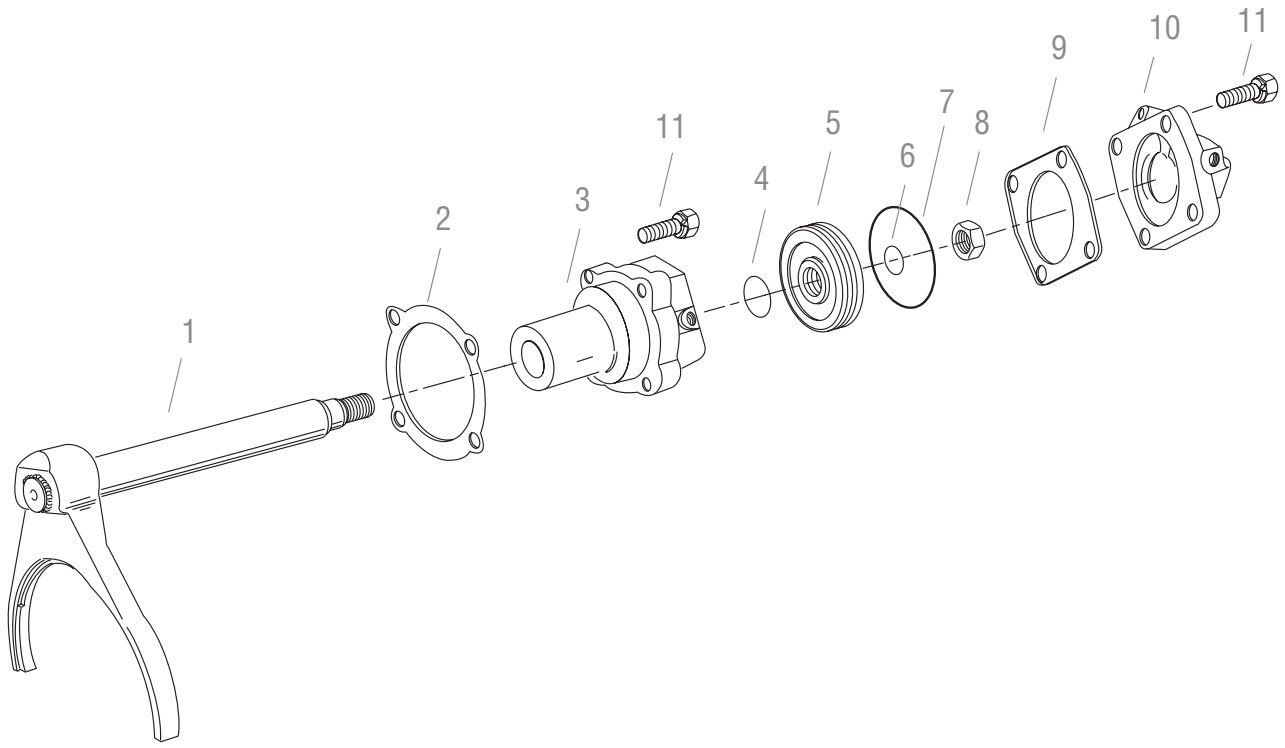
How to Disassemble the Range Cylinder Assembly

Special Instructions

None

Special Tools

- Typical service tools

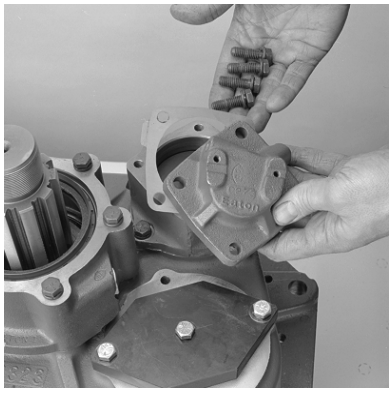


1. Yoke Bar
2. Gasket
3. Range Cylinder Assembly
4. O-Ring
5. Piston
6. O-Ring
7. O-Ring
8. Nut
9. Gasket
10. Cover
11. Capscrew

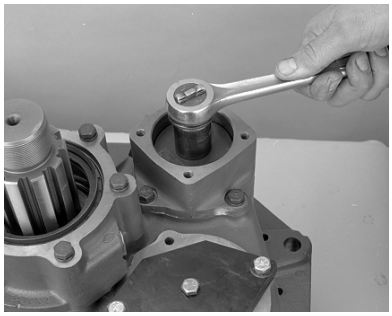
Procedure -

1. From the range cylinder cover, remove the capscrews, cover, and gasket.

2. Clean the gasket mounting surfaces of all gasket material.



3. From the range cylinder housing bore, remove the 15/16" nut.



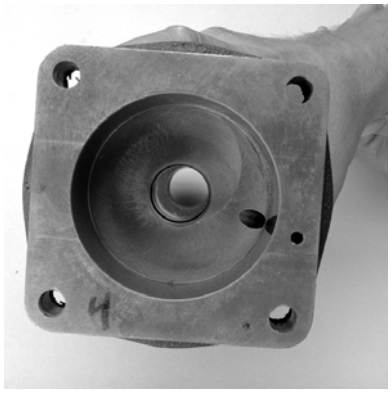
4. From the cylinder housing bore, remove the range piston.

5. Inspect the range piston O-rings, remove if damaged.

6. Remove the capscrews and range cylinder housing.

7. Clean the gasket mounting surfaces of all gasket material.

8. Inspect the O-ring inside the range cylinder housing bore, remove if damaged.



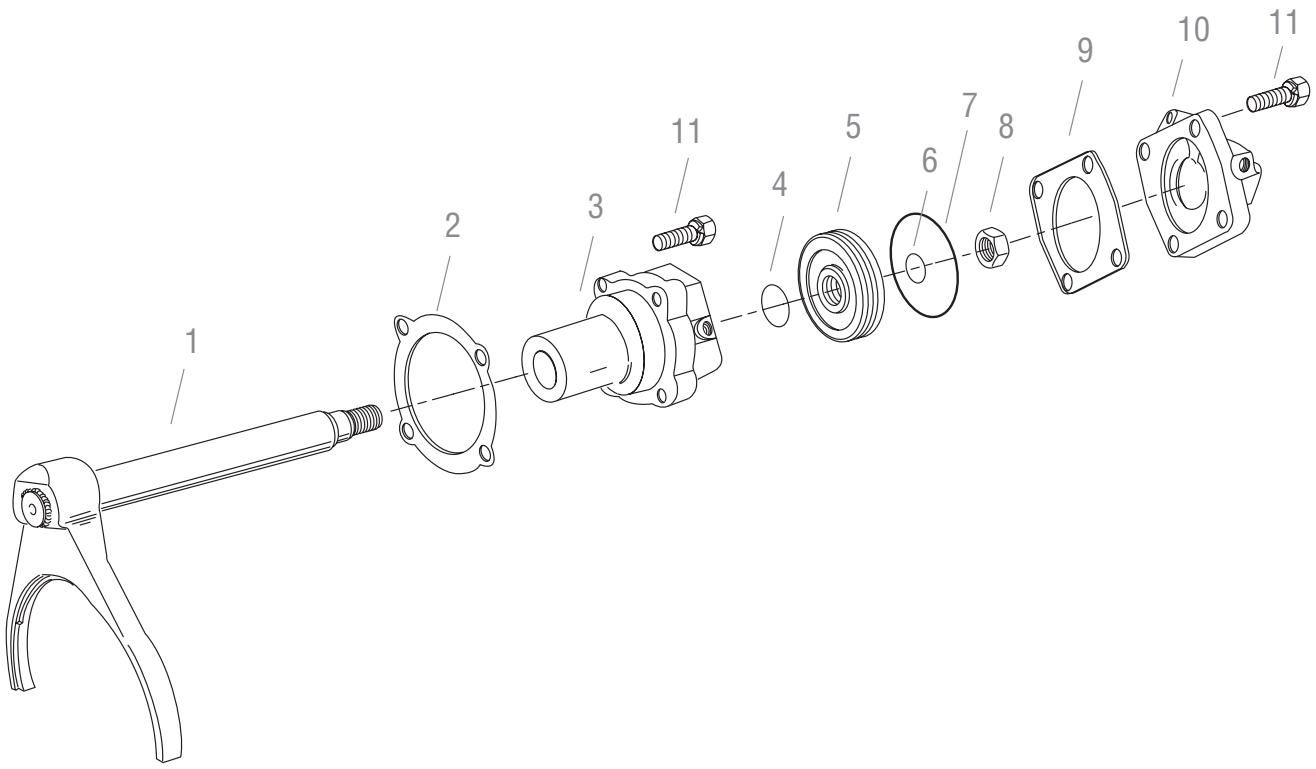
How to Assemble the Range Cylinder Assembly

Special Instructions

Apply Eaton lubricant #71214 or equivalent to shift cylinder assembly and insert valve O-rings so a film covers the entire surface of each O-ring.

Special Tools

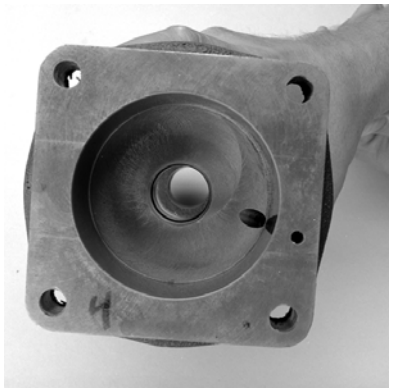
- Typical service tools



1. Yoke Bar
2. Gasket
3. Range Cylinder Assembly
4. O-Ring
5. Piston
6. O-Ring
7. O-Ring
8. Nut
9. Gasket
10. Cover
11. Capscrew

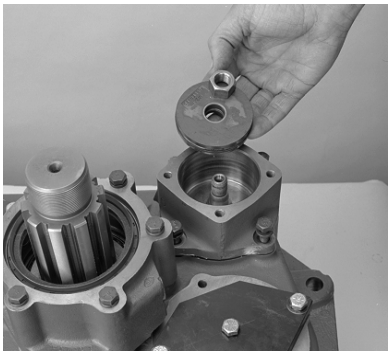
Procedure -

1. If previously removed, in the cylinder housing bore, install the small O-ring.

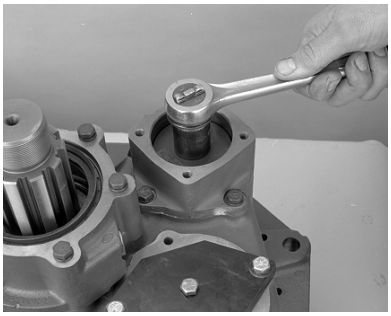


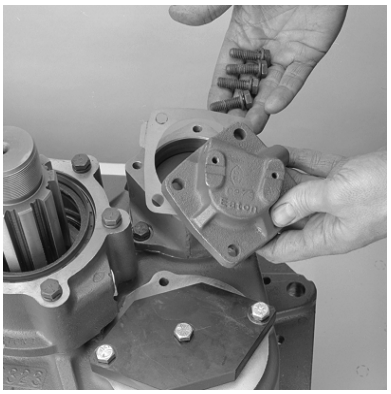
2. If previously removed, on the piston I.D. and O.D., install the piston O-rings.

3. Position a new gasket on the range cylinder housing mounting surface.
4. Install the cylinder housing.
5. Apply Eaton/Fuller sealant #71205 or equivalent to the retaining capscrews.
6. Install the capscrews, tighten to 20-25 Lb•ft of torque.
7. Lean auxiliary section back with range cylinder upward.
8. Insert the piston and push it in as far as it will go.



9. Secure the piston with the retaining nut, tighten to 70-85 Lb•ft of torque.





10. Position a new gasket on the cylinder housing cover mounting surface.

11. Over the gasket, position the range cylinder cover.

12. Apply Eaton/Fuller sealant #71205 or equivalent to the retaining capscrews.

13. Install the capscrews, tighten to 20-25 Lb•ft of torque.

How to Disassemble the Gear Shift Lever

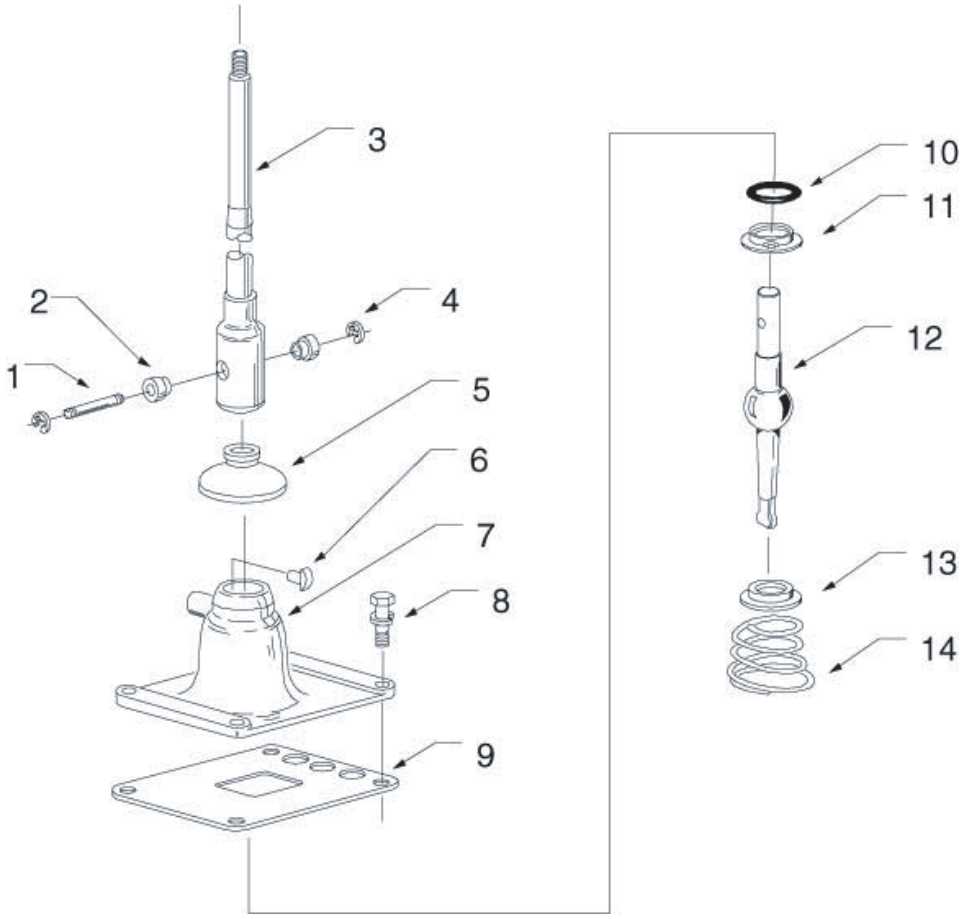
Special Instructions

If total disassembly is needed, the Roadranger® valve, must be removed first.

Release the spring one coil at a time.

Special Tools

- Vise with brass jaws or wood blocks



1. Pin
2. Bushing
3. Upper Lever
4. Snap Ring
5. Rubber Boot
6. Spade Pin
7. Housing
8. Capscrew
9. Gasket
10. O-Ring
11. Washer
12. Lower Lever
13. Stepped Washer
14. Tension Spring

Procedure -

1. On a non-isolated shift lever, remove the Roadranger® valve using the “How to Remove the Roadranger® valve” instructions in In-Vehicle Service Procedures. If the shift lever is equipped with a lever isolator, remove the snap ring, bushing, and cross pin to disconnect and remove the upper lever.
2. Slide the rubber boot up and off the shift lever shaft.
3. With housing bottom facing up, secure the assembly in a vise.
4. Use large screwdriver to twist between the spring and housing, forcing the spring from under the housing lugs one coil at a time.
5. From inside the housing tower, remove the tension spring, washer, and gear shift lever.
6. In models so equipped, from the housing bore, remove the nut and washer.

7. From the housing tower spade pin bore, remove and inspect the spade pin, discard if damaged.
8. From the housing tower inside groove, inspect the o-ring, discard if damaged.

How to Assemble the Gear Shift Lever

Special Instructions

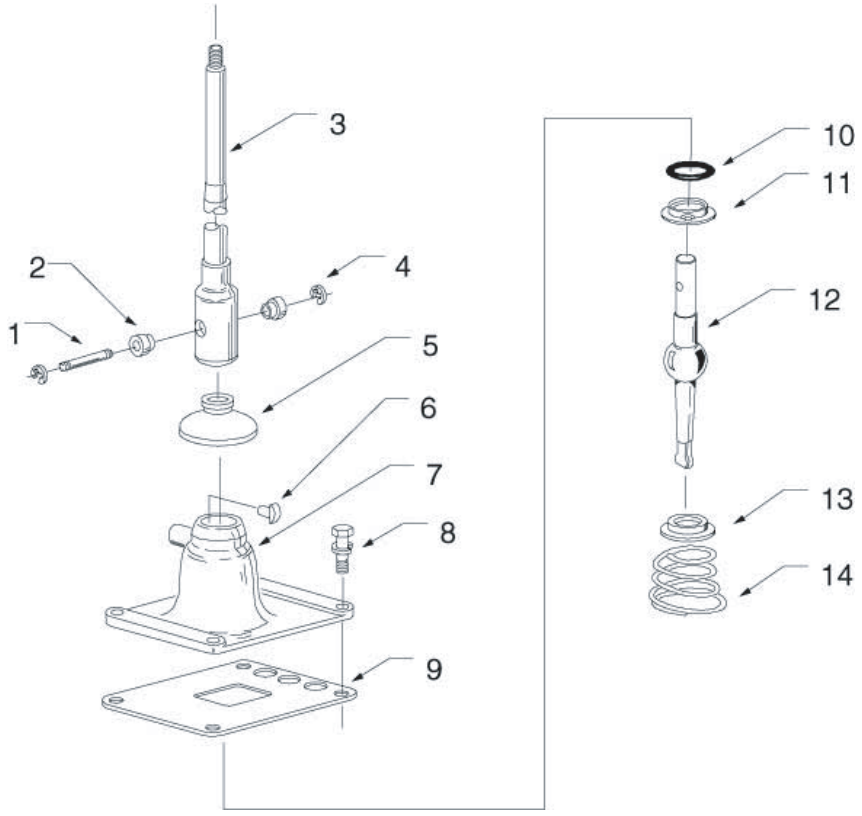
Inspect tension spring and washer for wear.

Apply Eaton® rust preventative lubricant #71212 or equivalent to the shift lever pivot ball. A rust preventative lubricant film should cover all surfaces between and including the pivot ball.

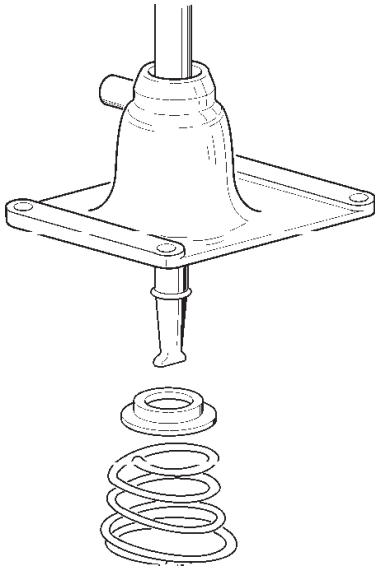
Seat the tension spring one coil at a time.

Special Tools

- Vise with brass jaws or wood blocks
- Item T4: Tension Spring Driver (see Table 6)



1. Pin
2. Bushing
3. Upper Lever
4. Snap Ring
5. Rubber Boot
6. Spade Pin
7. Housing
8. Capscrew
9. Gasket
10. O-Ring
11. Washer
12. Lower Lever
13. Stepped Washer
14. Tension Spring



Procedure -

1. With housing bottom facing up, secure the assembly in a vise.
2. If the spade pin is damaged, replace and install the spade pin, in housing tower bore.
3. In models so equipped, install the nut and washer in the housing bore.
4. If the o-ring is damaged, replace; lubricate the o-ring with Eaton® Fuller® lubricant #71206 or equivalent. Install the o-ring in the housing tower inside groove.
5. Align the lever ball slot with the spade pin and position the gear shift lever in the housing tower.
6. With dished-side up, install the washer over the ball.
7. Use a tension spring driver T4 to install the tension spring under the housing lugs.
8. Remove the assembly from the vise.
9. Install a rubber boot over the gear shift lever and against the housing.

   Note: Make sure the gear shift lever can move.

How to Remove the Shift Bar Housing

Special Instructions

Before removing the shift bar housing, the air lines must be disconnected.

For models equipped with an oil pump and/or cooler assemblies, make sure to disconnect the oil line connected to the shift bar housing.

There are three (3) sizes of capscrews. The 1 1/2" capscrews are used with the lifting eyes. The 1 1/4" are used on all other locations except the left front corner at the roll pin location. This capscrew is 1 3/4".

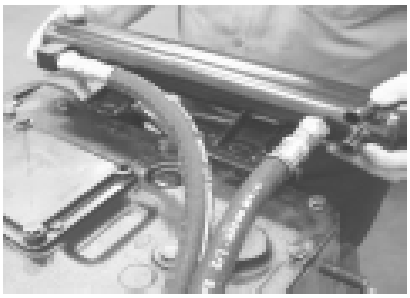
Be careful when removing the shift bar housing to prevent damaging the oil tube with the shift yokes.

Special Tools

- Typical service tools

Procedure -

1. From the shift bar housing, remove the two shift bar retaining capscrews securing the oil cooler. Remove oil cooler and set aside.

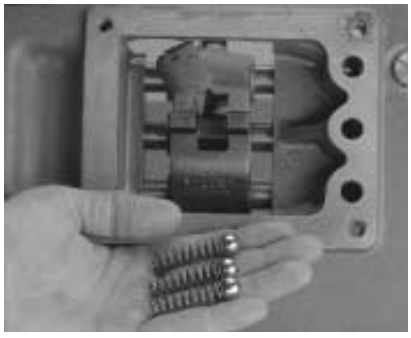


2. Remove slave valve.

3. Remove interlock parts (pin, spring, and sleeve).

4. From the shift bar housing rim, remove the retaining capscrews.
5. To break the gasket seal, jar the shift bar housing.

6. Remove the shift bar housing.
7. Inspect the roll pin, replace if damaged.
8. Remove the gasket and clean all mounting surfaces of gasket material.



9. If the three (3) sets of tension springs and balls from the housing top bores are loose, tilt the assembly and remove them.

How to Install the Shift Bar Housing

Special Instructions

There are three (3) sizes of capscrews. The 1 1/2" capscrews are used with the lifting eyes. The 1 1/4" are used on all other locations except the left front corner at the roll pin location. This capscrew is 1 3/4".

Be careful when removing the shift bar housing to prevent damaging the oil tube with the shift yokes.

The slave valve and interlock parts must be removed prior to installing the shift bar housing.

Special Tools

- Typical service tools

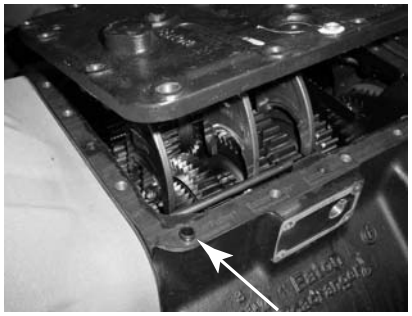
Procedure -

1. Place the shift bar housing and shift blocks in the neutral position.

2. Place the mainshaft sliding clutches in the neutral position.

3. Position a new shift bar housing gasket on the shift bar housing mounting surface.

   Note: The slave valve and interlock assembly must remain off, until the shift bar housing is installed, to avoid damaging the interlock pin.



4. As you install the shift bar housing, make sure the yokes fit into the corresponding sliding clutch slots and the housing aligns with the roll pin.

5. Apply Eaton® Fuller® Sealant #71205 or equivalent to the retaining capscrew threads.

6. Install interlock parts (pin, spring and sleeve).

7. Install slave valve and tighten to specifications.

How to Disassemble the Shift Bar Housing Assembly

Special Instructions

Before removing the shift bar housing, the air lines must be disconnected.

There are two (2) sizes of capscrews. The 1 - 1/2" capscrews are used with the lifting eyes. Note their location

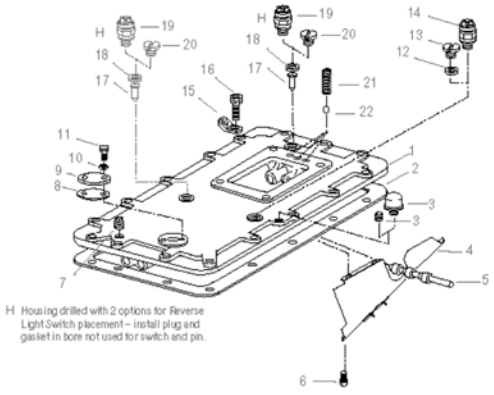
Be careful when removing shift bar housing to not damage oil tube with shift yokes.

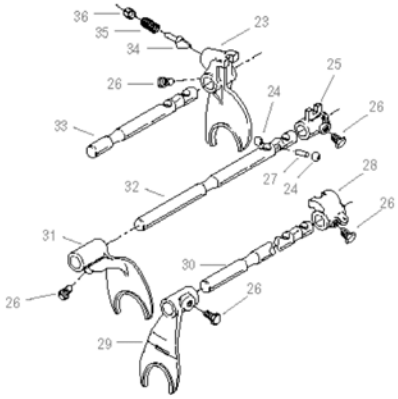
For models equipped with an Oil Pump and/or Cooler Assemblies, make sure to disconnect the lube line at the fitting on the shift bar housing before doing the following instructions.

Note: Forward Shift Bar Housing removal follows the same procedure.

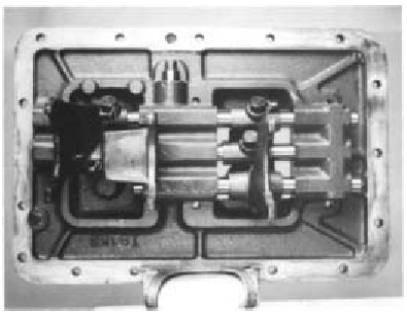
Special Tools

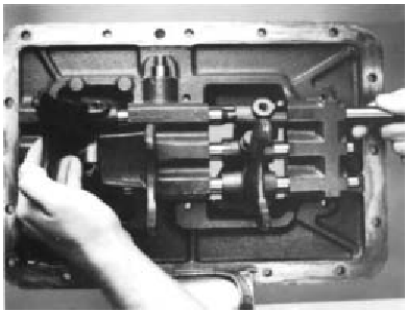
- Typical service tools

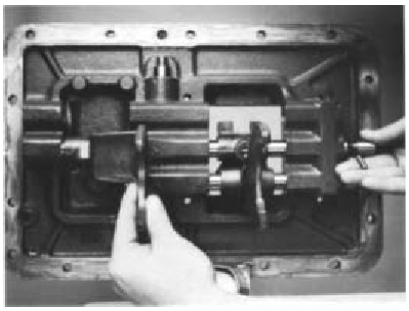

H Housing drilled with 2 options for Reverse Light Switch placement – install plug and gasket in bore not used for switch and pin.

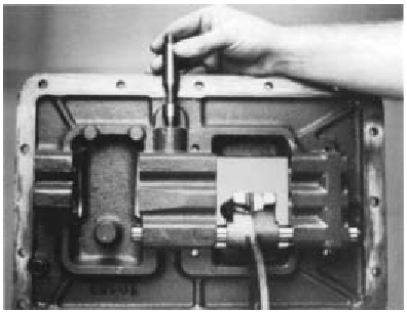


1. Shift Bar HSG (STD)
2. Gasket
3. Breather and Pipe Plug
4. Oil Trough
5. Air Valve Shaft
6. Capscrew
7. Pipe Plug
8. Gasket
9. Plate
10. Lockwasher
11. Capscrew
12. Gasket
13. Plug
14. Neutral Light Switch
15. Lifting Eye
16. Capscrew
17. Pin
18. Gasket
19. Reverse Light Switch
20. Plug
21. Spring
22. Steel Ball
23. Shift Yoke
24. Steel Ball
25. Shift Block
26. Lockscrew
27. Interlock Pin
28. Shift Block
29. Shift Yoke
30. Yoke Bar
31. Shift Yoke
32. Yoke Bar
33. Yoke Bar
34. Plunger
35. Spring
36. Shift Bar HSG (STD)









Procedure -

1. Secure the assembly in a vise with the plunger side up. (The front of the housing will be to the left.) For models so equipped, cut the lockwire and turn out the retaining capscrews to remove the oil trough from the housing.

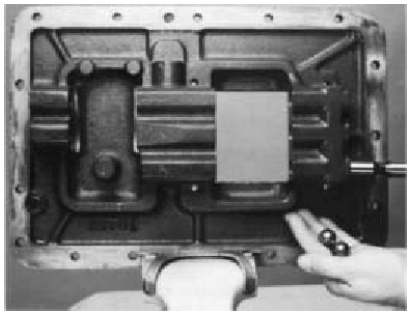
   Note: Start with the upper shift bar, move all bars to the right and out the rear boss bore. Cut the lockwire and remove the lockscrews from each bar just before their removal.

2. Move the 3rd-4th speed shift bar to the housing rear, removing the yoke and block from the bar.

3. Move the 1st-2nd speed shift bar to the housing rear, removing the yoke and block from the bar. As the neutral notch in the bar clears the rear boss, remove the small interlock pin from the bore.

4. Remove the actuating plunger from the center boss bore.

5. Move the short LO-Reverse speed shift bar to the housing rear, remove the yoke from the bar. As the shift bar is removed from the housing, two 3/4 interlock balls will drop from the rear boss bottom bore.



6. If necessary, remove the plug, spring, and reverse stop plunger from the LO-Reverse speed shift yoke bore.

How to Reassemble the Shift Bar Housing Assembly

Special Instructions

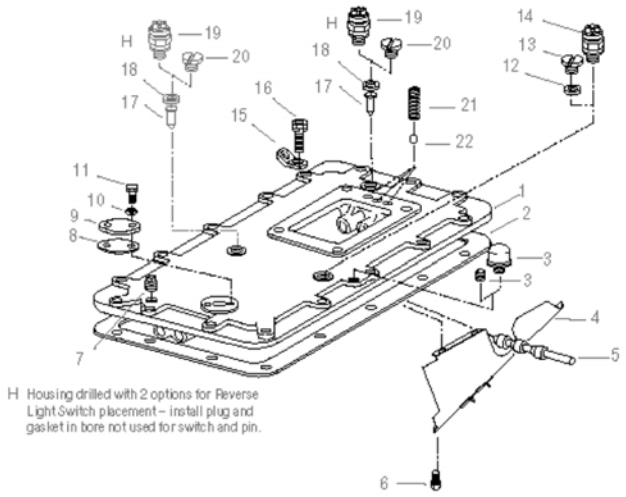
There are two (2) sizes of capscrews. The 1 - 1/2" capscrews are used with the lifting eyes. Note their location

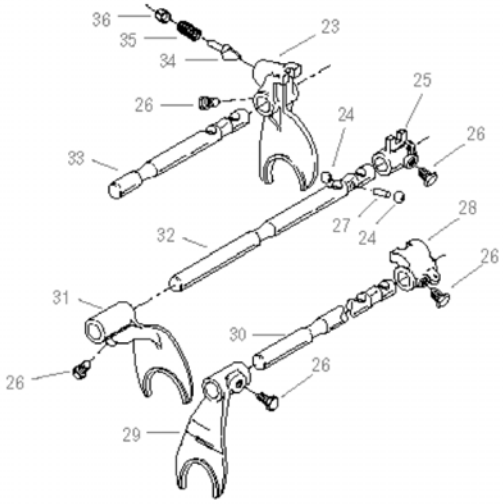
Be careful when installing the shift bar housing to not damage oil tube with shift yokes.

Note: Forward Shift Bar Housing installation follows the same procedure.

Special Tools

- Typical service tools


H Housing drilled with 2 options for Reverse Light Switch placement – install plug and gasket in bore not used for switch and pin.



1. Shift Bar HSG (STD)
2. Gasket
3. Breather and Pipe Plug
4. Oil Trough
5. Air Valve Shaft
6. Capscrew
7. Pipe Plug
8. Gasket
9. Plate
10. Lockwasher
11. Capscrew
12. Gasket
13. Plug
14. Neutral Light Switch
15. Lifting Eye
16. Capscrew
17. Pin
18. Gasket
19. Reverse Light Switch
20. Plug
21. Spring
22. Steel Ball
23. Shift Yoke
24. Steel Ball
25. Shift Block
26. Lockscrew
27. Interlock Pin
28. Shift Block
29. Shift Yoke
30. Yoke Bar
31. Shift Yoke
32. Yoke Bar
33. Yoke Bar
34. Plunger
35. Spring
36. Shift Bar HSG (STD)

Procedure -

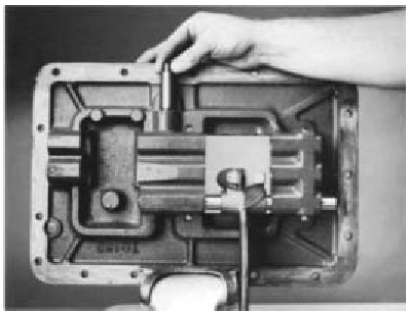
1. If previously removed, install the reverse-stop plunger in the LO-Reverse shift yoke, making sure the plunger is fully seated in the yoke slot bore.

2. Install the spring in the yoke bore and on the plunger shank.

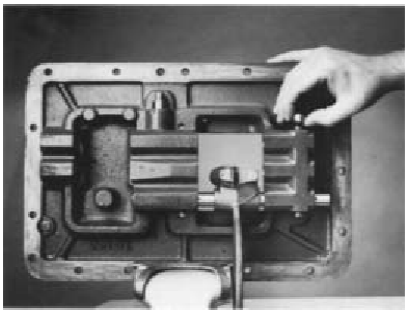
3. Install the plug and tighten to compress the spring (left). Back the plug out 1 - 1.5 turns and stake the plug through the small hole in the yoke (right.)

4. Secure the shift bar housing in a vise and hold the notched-end of the short LO-Reverse speed shift bar. Install the bar in the lower bore of the shift bar housing bosses. Install the yoke lockscrew, tighten and wire securely.

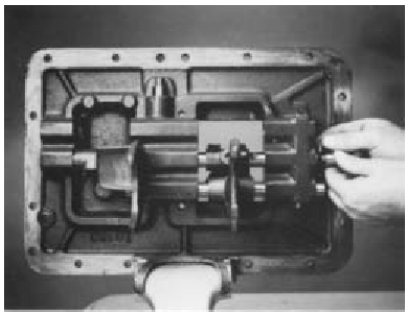
   Note: Start with the lower shift bore of the rear boss and move to the left (front of the housing). Keep bars in the neutral position during installation. Do not exceed the recommended torque ratings for the yoke lockscrews as over-tightening may distort the shift bars.



5. While holding the plunger shank, install the actuating plunger in the center boss bore.

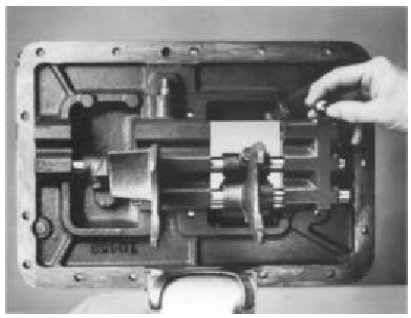


6. Install one 3/4" interlock ball in the rear boss top bore. This ball rides between LO-Reverse and 1st-2nd speed shift bars.



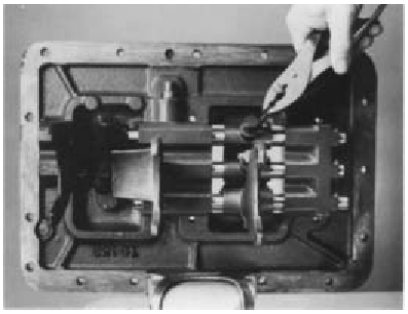
7. While holding the notched-end of the bar, install the 1st-2nd speed shift bar in the housing boss middle bore. Position the shift block on the bar between the center and rear bosses, and the yoke on the bar between the front and center bosses, long hub to the housing front. Just before inserting the notched-end of the rear boss bar, install the small interlock pin vertically in the neutral notch bore. Install the block and yoke lockscrews, tighten, and lockwire securely.

   Note: It is necessary that the interlock pin remain in a vertical position during reassembly as rotation of the bar causes the pin to jam in the tension spring bores.



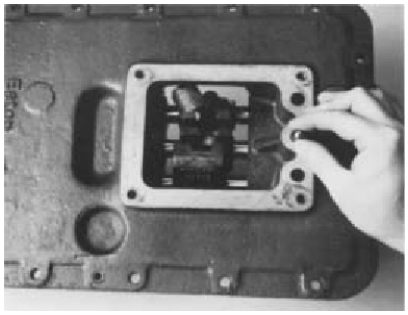
8. Install the other 3/4" interlock ball in the rear boss top bore. This ball rides between the 1st-2nd and the 3rd-4th speed shift bars.

9. While holding notched-end of the bar, install the 3rd-4th speed shift bar in the housing boss upper bore. Position the shift block on the bar between the front and center bosses, long hub to the housing rear. Install the block and yoke lockscrews, tighten and lockwire securely.

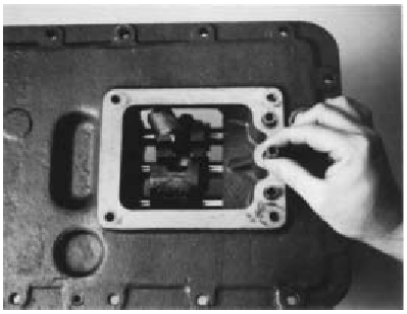


10. For models so equipped, install the oil trough on the housing. Tighten the capscrews and lockwire securely.

11. Remove the assembly from the vise. Install the three tension balls, one in each bore on the housing top.



12. Install the three tension springs, one over each ball in the housing bores.



How to Remove the Input Shaft Assembly (without main case disassembly)

Special Instructions

None

Special Tools

- See Tool Information (see Table 6)
- Item T21: Bearing puller
- Soft bar and maul

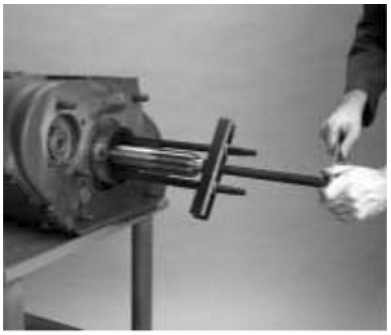
Procedure -

1. From the front bearing cover, remove the six (6) retaining capscrews and cover. Remove any remaining gasket material from the case and cover.

2. If present, remove and discard the rubber seal ring on the input shaft. The ring is used only to seal the transmission during shipment.

3. From the input shaft groove, remove the bearing retaining snap ring.

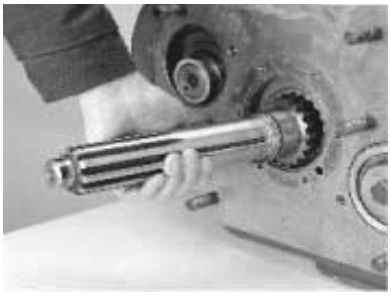
4. Use a soft bar and maul to drive the input shaft toward the case rear as far as possible. Pull the input shaft forward.



5. Install the bearing puller tool and remove the input bearing from the case and input shaft or use pry bars or screwdrivers to complete removal of the bearing.

6. From the drive gear front, remove drive gear spacer.

7. Remove the drive gear internal snap ring.



8. Pull the input shaft forward and out of the drive gear.

9. Inspect the bushing in the input shaft pocket, replace if damaged.

How to Install the Input Shaft Assembly (without main case disassembly)

Special Instructions

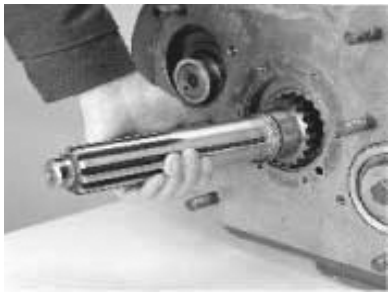
None

Special Tools

- See Tool Information (see Table 6)
- Item T12: Input bearing driver
- Toolmaker's dye

Procedure -

1. If necessary, install the bushing in the back of the input shaft.



2. From the front, engage the input shaft spline teeth into the main drive gear.

   Note: The current design input shaft spline teeth have noticeable clearance to the main drive gear internal spline teeth. This is normal.

3. Install the snap ring in the main drive gear inside groove.

4. Install the spacer washer over the input shaft. With the bearing external snap ring to the outside, position the bearing on the input shaft.

5. Install the input shaft bearing over the input shaft. Use a flanged-end bearing driver which contacts both the bearing inner race and outer race. Drive the bearing until it contacts the front case.

6. Install the input shaft retaining snap ring.

   Note: Do not replace the small rubber lip seal. It is used only to prevent leakage during shipping.

7. Install the front bearing cover. Apply Loctite 242 to cap-screw threads and torque to 35-45 lb-ft (47.45-61.01 N•m).

How to Remove the Auxiliary Section with Tapered Bearings

Special Instructions

There can be different capscrew lengths, note their location.

Auxiliary sections can be removed either with the transmission in the horizontal position or the vertical position.

Auxiliary countershaft retaining straps may be installed to hold the countershafts in place. You can make retaining straps from 3" x 1" bar stock. Auxiliary can be removed without straps, use caution.

Special Tools

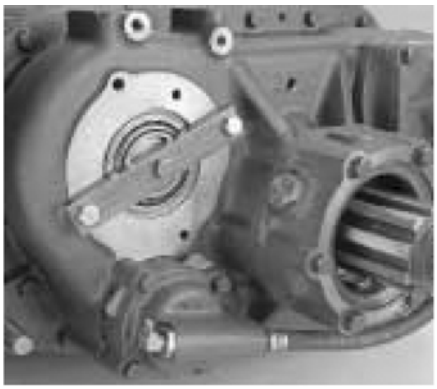
- Item T2: Auxiliary section hanger bracket for horizontal removal
- A steel bar longer than the width of the output yoke for vertical removal
- A hoist with a lifting chain
- Auxiliary countershaft retaining straps

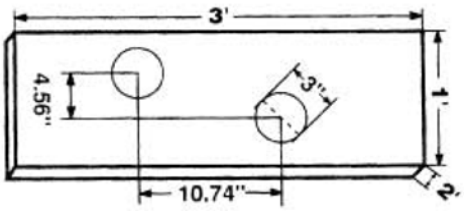
Procedure -

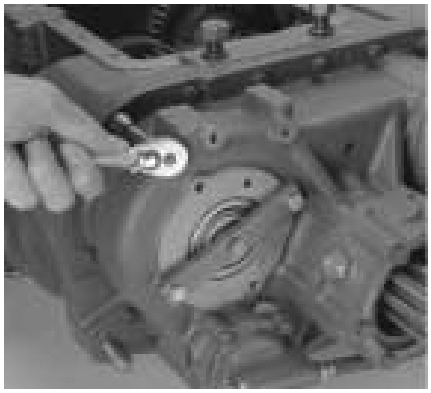
1. **To remove the auxiliary section in the horizontal position.** Remove the four (4) capscrews and the auxiliary countershaft rear bearing cover, gasket, and rear bearing shim.

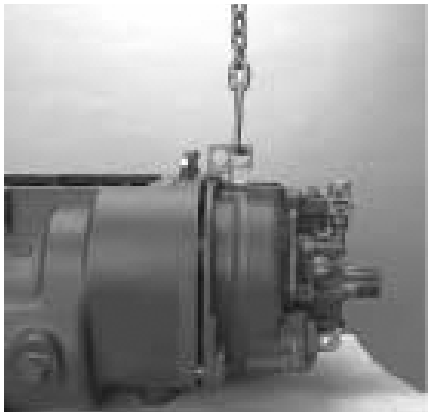
2. Install the auxiliary countershaft retaining straps with 2 - 3/8" NC x 1" and 1 - 3/8" NC x 1 - 1/2" clean capscrews.

   Note: Do not use an air gun. Tighten by hand until the capscrews are snug.









3. From the auxiliary section housing, remove the retaining capscrews that attach the front section to the auxiliary section.

4. Insert the two (2) longest capscrews in the housing flange tapped holes. Tighten evenly to move the auxiliary section away from the front box. Go far enough to break the gasket seal.

5. Remove the capscrews from the tapped holes.

6. Attach an auxiliary section hanger bracket to the auxiliary section top.

7. Attach a lifting chain to the auxiliary section hanger bracket.

8. Move assembly to the rear until auxiliary section is free.

9. Remove the gasket and clean all mounting surfaces of gasket material.

Procedure -

1. **To remove the auxiliary section in the vertical position.** With blocks under the clutch housing to prevent input shaft damage, place transmission in the vertical position, clutch housing down.

2. Remove the four (4) capscrews and the auxiliary countershaft rear bearing cover, gasket, and rear bearing shim. Clean the gasket surface area.

3. Install the auxiliary countershaft retaining straps with 2 - 3/8" NC x 1" and 1 - 3/8" NC x 2 - 1/2" clean capscrews.

   Note: Do not use an air gun. Tighten by hand until the capscrews are snug.

4. From the auxiliary section housing, remove the retaining capscrews that attach the front box to the auxiliary section.

5. Install a steel bar through the yoke.

6. Attach a lifting chain to the steel bar.

7. Lift assembly from the front section.

How to Remove the Auxiliary Countershaft Assemblies (w/Tapered Bearings)

Special Instructions

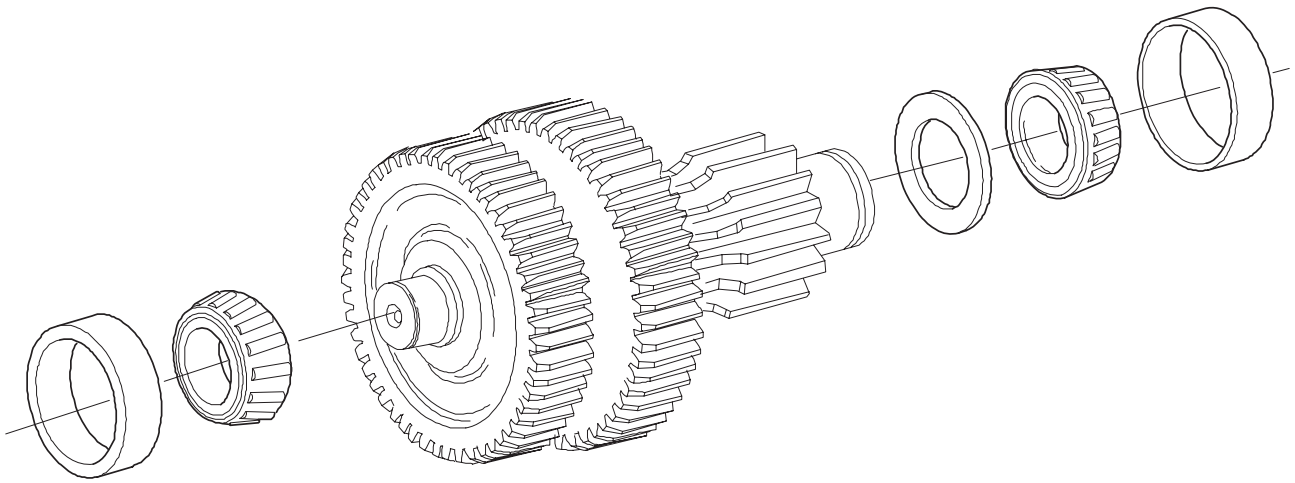
For ease of disassembly, mount the auxiliary section upright in a vise.

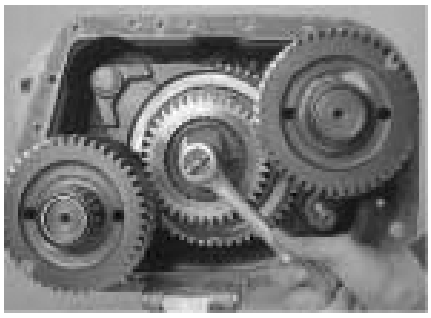
Both countershafts are removed the same.

As the countershaft strap is removed, the countershaft can fall.

Special Tools

- See Tool Information (see Table 6)
- Vise with brass jaws or wood blocks
- Item T11: Bearing Puller
- Soft bar and maul





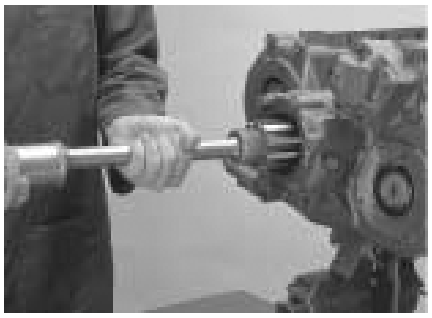
Procedure -

1. To hold the auxiliary countershafts from turning, place a shop rag or equivalent between the splitter gear and one countershaft.

2. From the output shaft, loosen the 15/16" capscrew and retainer. Do not remove the capscrew.

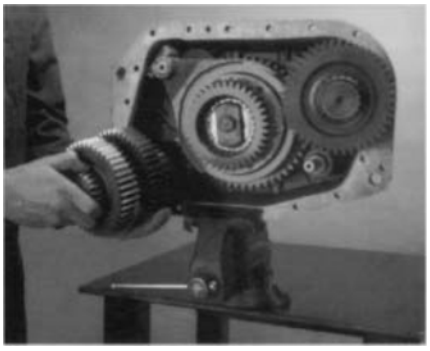
3. Install countershaft retaining strap.

4. Use a soft bar and maul to drive the output shaft forward far enough to partially unseat the bearing.

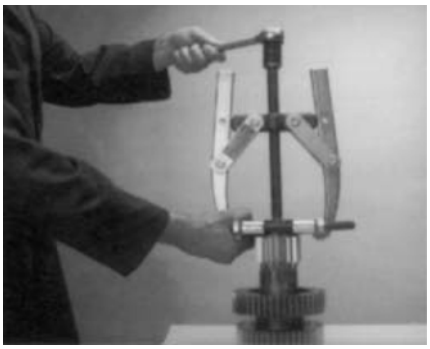


5. Support the auxiliary countershaft while removing the auxiliary countershaft retaining strap.

6. Remove the auxiliary countershaft.



7. Remove the auxiliary countershaft bearing race from bore.



8. If necessary, secure the countershaft assemblies in a vise and remove both the front and rear bearings with a bearing separator and jaw pullers.

How to Remove the Countershaft Assemblies (w/Ball Bearings) A Series

Special Instructions

For ease of disassembly, mount the auxiliary section upright in a vise.

Both countershafts are removed the same.

When driving that countershaft to the rear, be careful not to damage the bearing inner race.

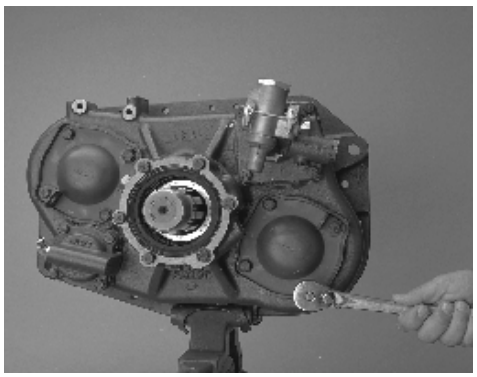
As the rear bearing is removed, the countershaft will fall.

Special Tools

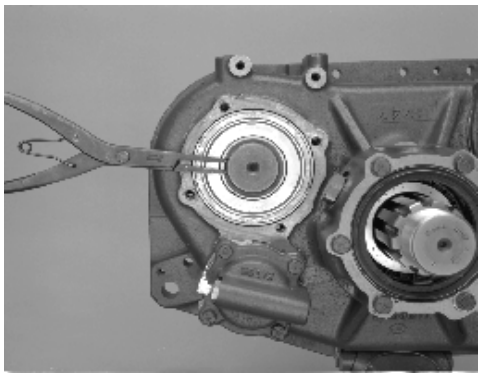
- Typical Service Tools
- Vise with brass jaws or wood blocks
- Bearing puller
- Soft bar and a maul

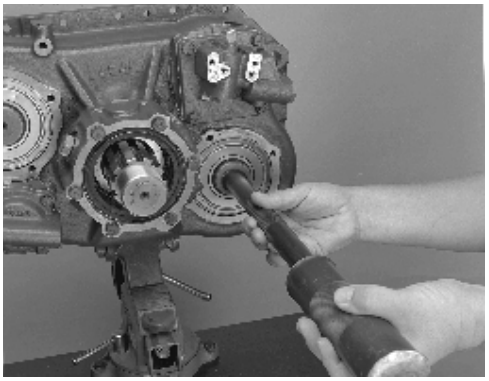
Procedure -

1. From the countershaft rear bearing cover, remove the cap-screws, cover, and gasket.

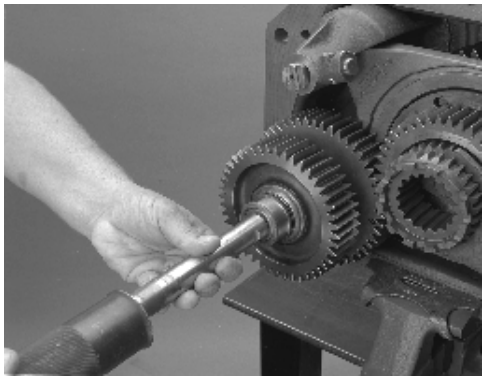


2. Clean the gasket mounting surface of gasket material.
3. From the countershaft rear, remove the snap ring.





4. Use a sort bar and maul to drive the countershaft forward far enough to partially unseat the bearing.



5. Use a soft bar and maul to drive the countershaft to the rear. This exposes the bearing snap ring.

6. Use a bearing puller and remove the countershaft bearing and countershaft.

7. Inspect the countershaft bearing inner race, remove if necessary.

How to Remove the Splitter Cylinder Assembly

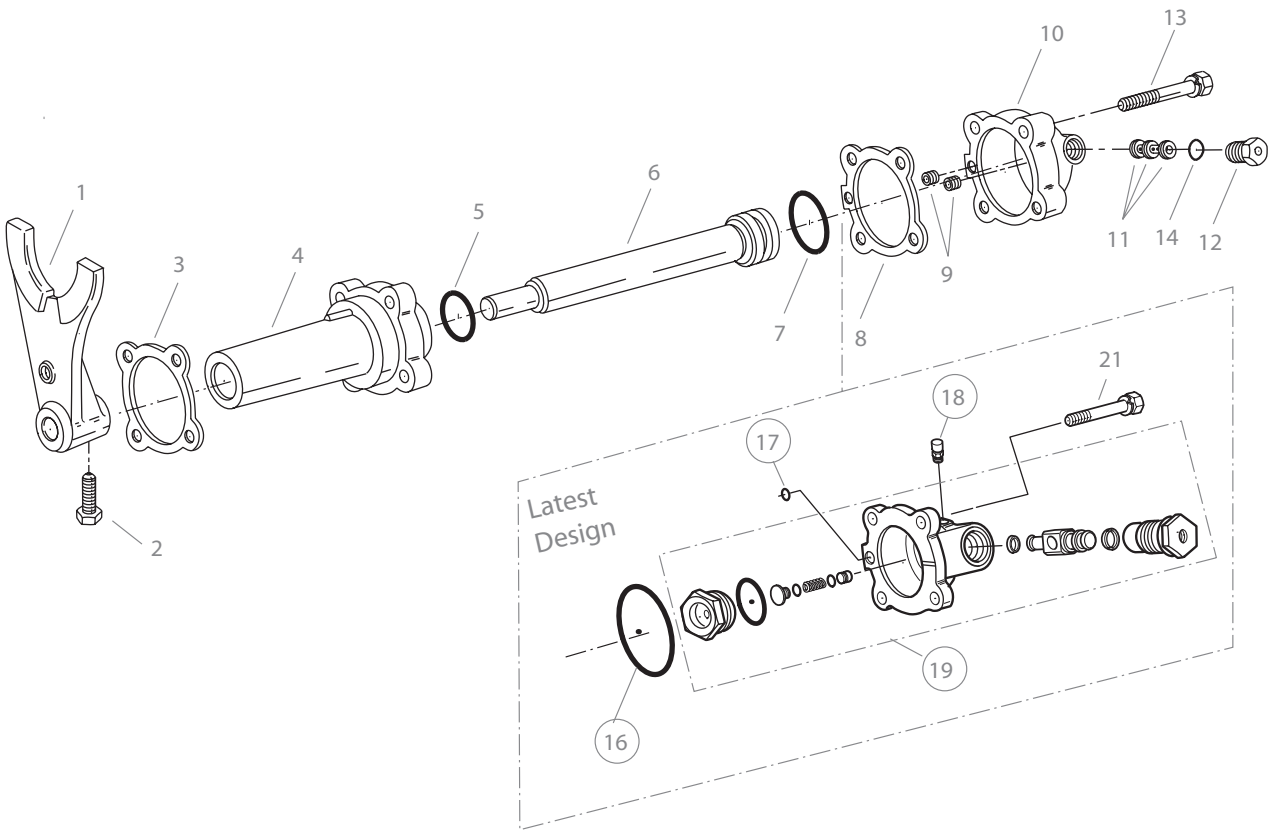
Special Instructions

When removing the splitter cylinder cover insert valve, note the direction the insert valve was positioned (nipple in or out).

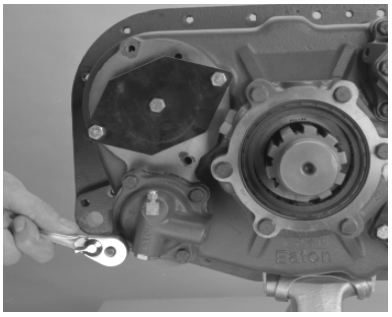
Auxiliary section must be removed to remove the splitter piston and splitter cylinder.

Special Tools

- Typical service tools

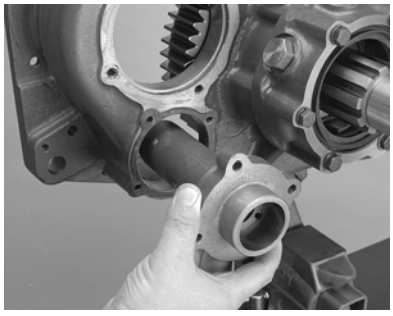


1. Shift Yoke
2. Lockscrew
3. Gasket
4. Splitter Cylinder
5. O-Ring
6. Yoke Bar
7. O-Ring
8. Gasket
9. Plug
10. Cover
11. Insert Valve
12. Reducer Bushing
13. Capscrew
14. O-Ring
16. O-Ring
17. O-Ring
18. Breather
19. Splitter Valve Kit
21. Capscrew



Procedure -

1. Drain lube.
2. Remove the auxiliary case (Use How to remove the Auxiliary section procedure).
3. Remove wire from splitter yoke retaining bolt and remove bolt.
4. From the splitter cylinder cover, remove the retaining cap-screws.
5. Remove the cover and gasket or O-ring (new design, aluminum cover).
6. Remove the splitter cylinder from the housing.



7. From the auxiliary rear, remove the splitter cylinder housing.
8. If necessary, turn out the insert valve retaining nut and remove insert valve from bore (only present on 13 Speed.)

How to Remove the Splitter Gear

Special Instructions

None

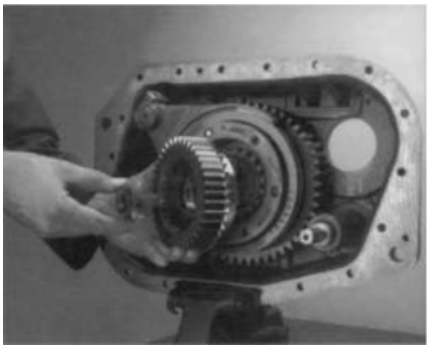
Special Tools

- Typical service tools

Procedure -

1. From the output shaft, remove the 15/16" capscrew and retainer bolt.

2. From the output shaft, remove the splitter gear.



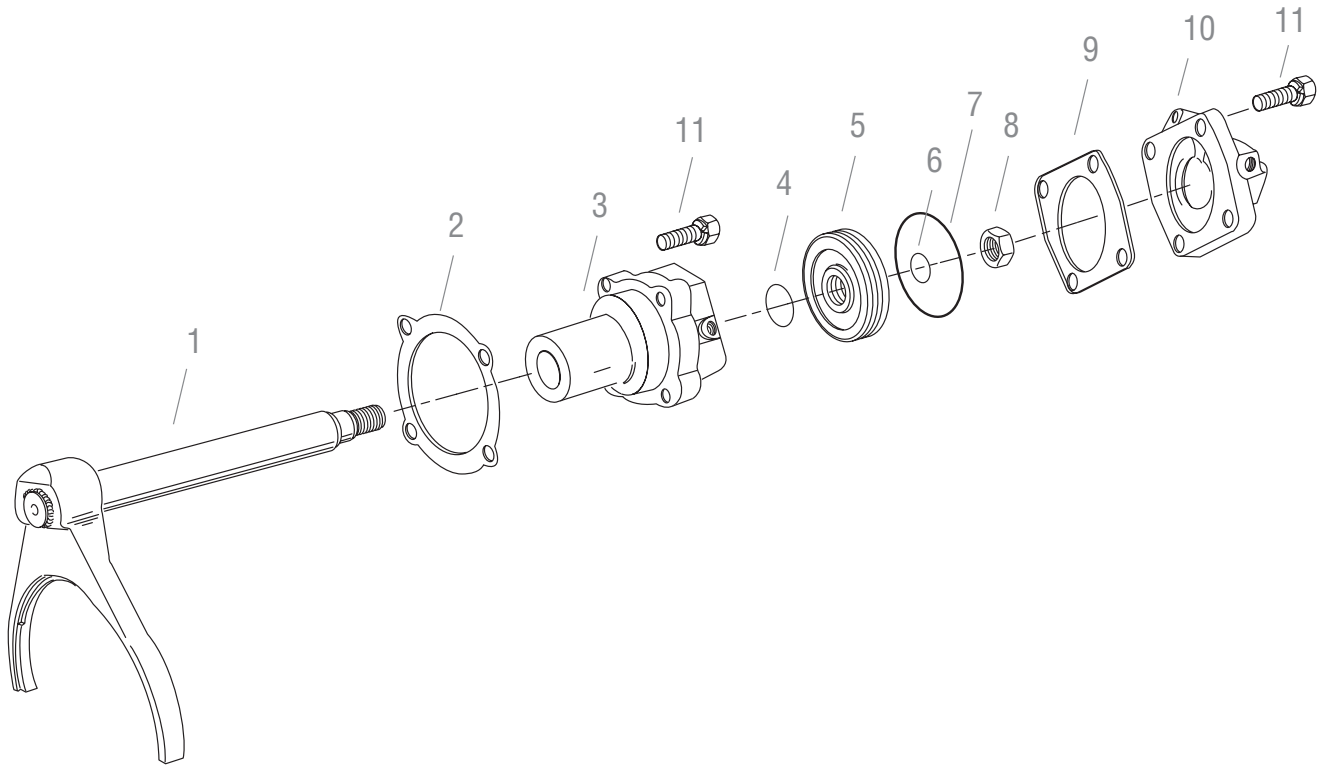
How to Disassemble the Range Cylinder Assembly

Special Instructions

None

Special Tools

- Typical service tools

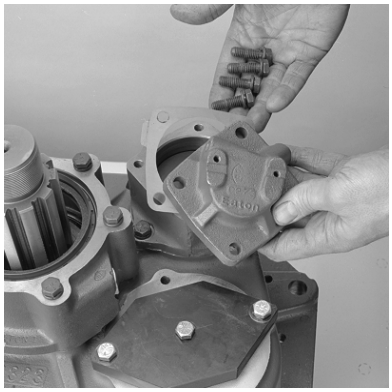


1. Yoke Bar
2. Gasket
3. Range Cylinder Assembly
4. O-Ring
5. Piston
6. O-Ring
7. O-Ring
8. Nut
9. Gasket
10. Cover
11. Capscrew

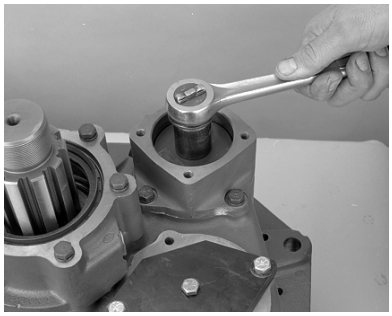
Procedure -

1. From the range cylinder cover, remove the capscrews, cover, and gasket.

2. Clean the gasket mounting surfaces of all gasket material.



3. From the range cylinder housing bore, remove the 15/16" nut.



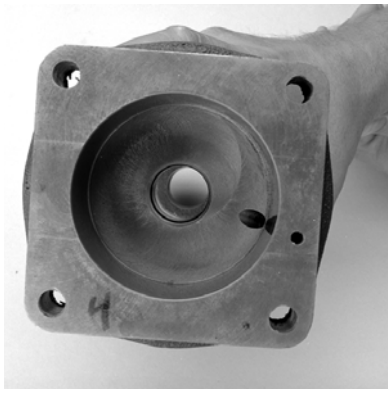
4. From the cylinder housing bore, remove the range piston.

5. Inspect the range piston O-rings, remove if damaged.

6. Remove the capscrews and range cylinder housing.

7. Clean the gasket mounting surfaces of all gasket material.

8. Inspect the O-ring inside the range cylinder housing bore, remove if damaged.



How to Disassemble the Output Shaft Assembly

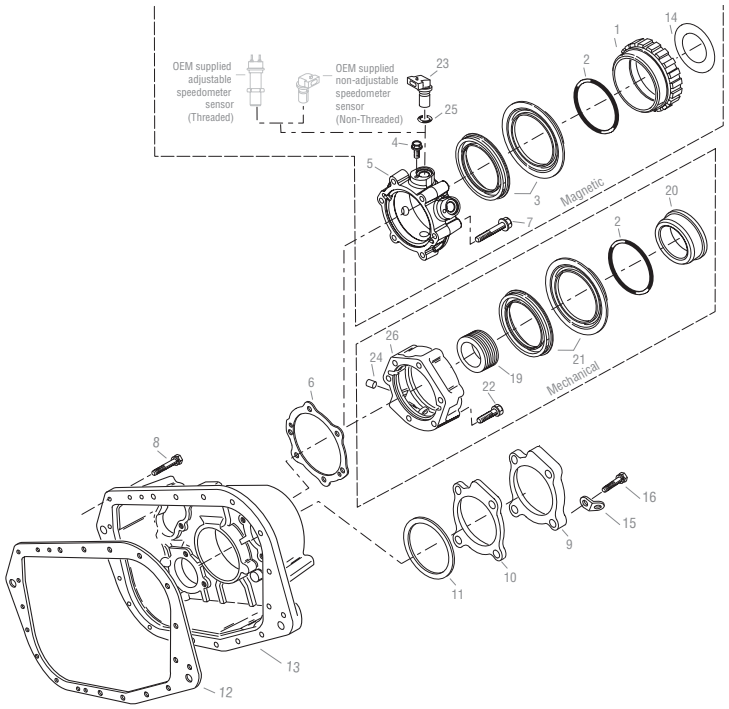
Special Instructions

When using the soft bar and maul on the output shaft, be careful not to damage the threads.

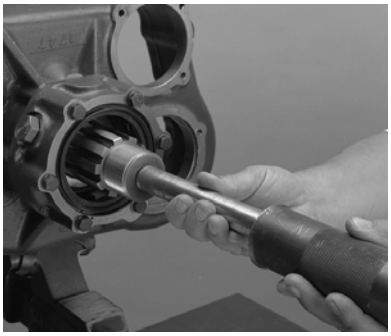
When removing the rear bearing cover, the rear bearing cone drops from the housing bore.

Special Tools

- Vise with brass jaws or wood blocks
- Press
- Soft bar and maul

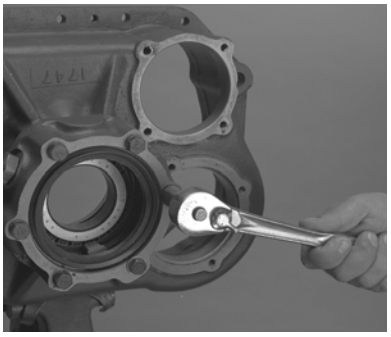


1. Speedo Rotor Assembly
2. O-Ring
3. Oil Seal Kit
4. Capscrew
5. Rear Bearing Cover Assembly
6. Gasket
7. Capscrew
8. Capscrew
9. Cover
10. Gasket
11. Shim Kit
12. Gasket
13. Rear Housing
15. Lifting Eye
16. Capscrew
19. Speedo Drive Gear
20. Speedo Spacer Assembly
21. Oil Seal w/Slinger
22. Capscrew
23. Speed Sensor Kit
24. Bushing
25. O-Ring
26. Rear Bearing Cover Assembly

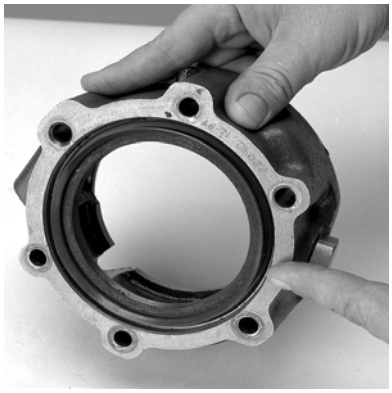


Procedure -

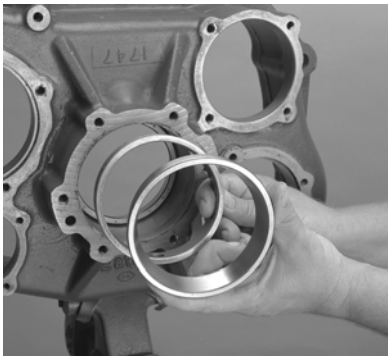
1. Use a soft bar and maul to drive the output shaft forward and through the rear bearing assembly.



2. From the auxiliary housing rear, remove the rear bearing retaining capscrews, cover, and gasket.
3. Clean the gasket mounting surface of gasket material.



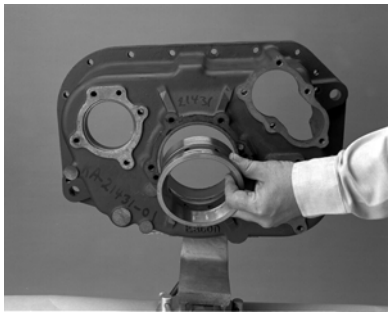
4. Inspect the rear bearing cover oil seal for damage, remove if damaged.



5. From the auxiliary housing rear, remove the bearing cup and spacer.

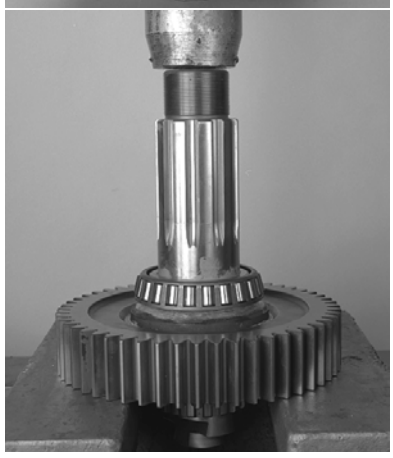
6. From the auxiliary housing front, remove the remaining bearing cup.

7. Some models have a one piece bearing race. Remove it from the bearing bore.



8. From the output shaft, remove the bearing inner spacer.

9. Use the output shaft assemble gear front face as a base, press the output shaft through the bearing and gear.



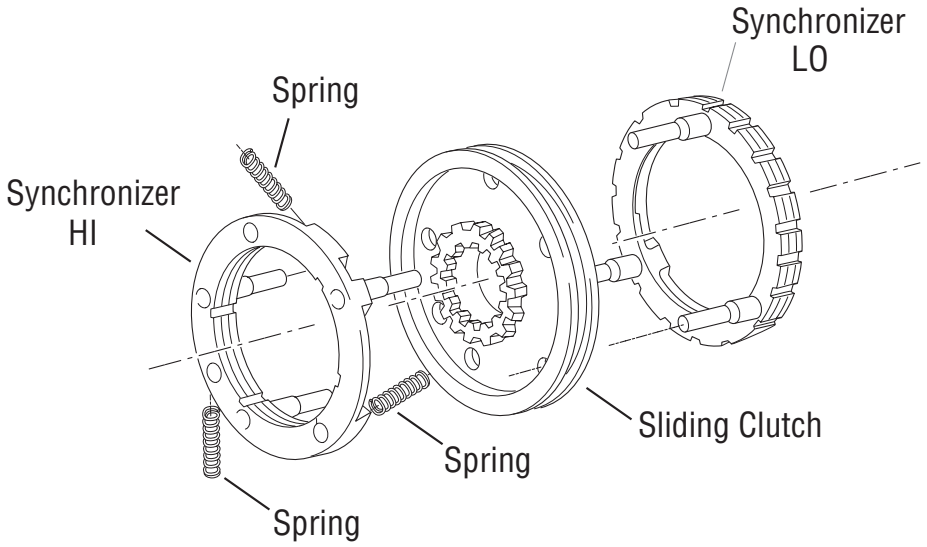
How to Disassemble the Synchronizer Assembly

Special Instructions

Place the synchronizer assembly on a clean, flat surface. Cover the synchronizer assembly with a shop rag to prevent losing the three (3) springs under pressure from the HI range synchronizer pin locations.

Special Tools

- Typical service tools



Procedure -

1. Place the larger LO range synchronizer ring on the bench.
2. Cover the synchronizer with a shop rag to contain the springs.
3. Grab both sides of the HI range synchronizer and pull.
4. From the synchronizer ring LO range pins, remove the sliding clutch.

How to Assemble the Synchronizer Assembly

Special Instructions

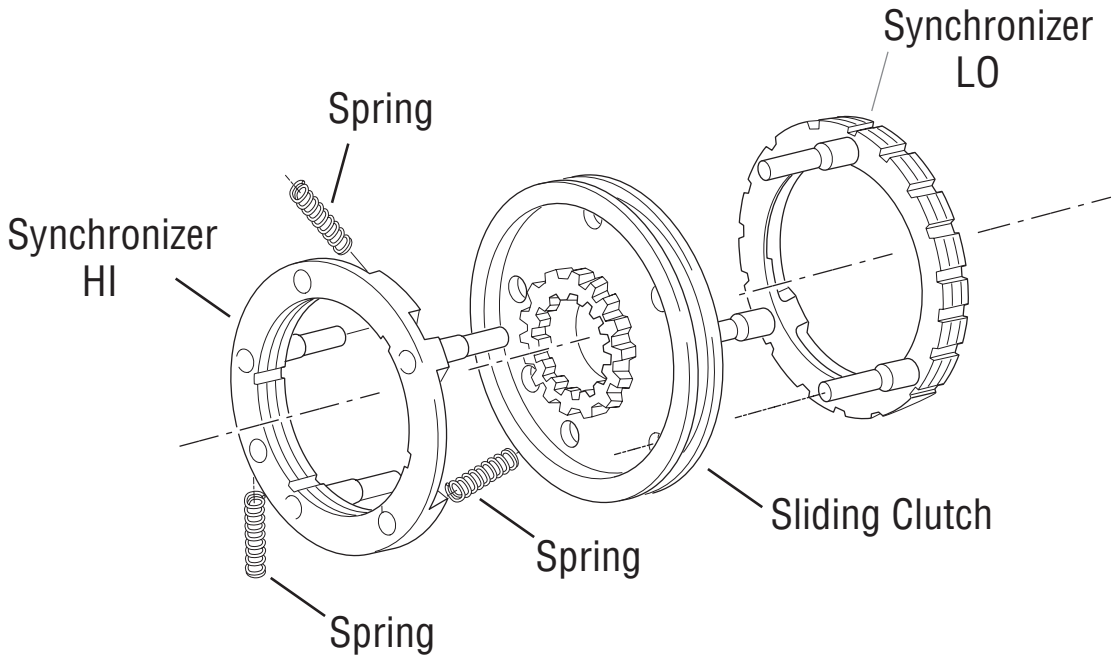
Assembly should be done on a clean, flat surface slightly lower than your waist.

Pins on the LO range synchronizer must line up with the chamfered holes on the sliding clutch bottom.

When compressing the HI range synchronizer springs cover with a shop rag. In the event compression is not achieved the first time, this prevents the springs from leaving the bench area.

Special Tools

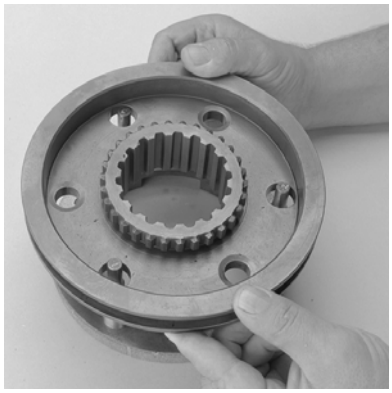
- Typical service tools

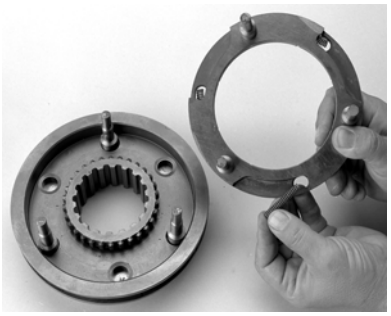


Procedure -

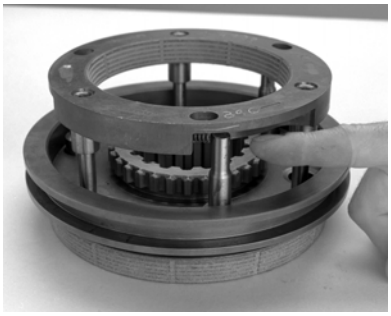
1. On the bench place the larger LO range synchronizer ring face down with pins up.

2. With the sliding clutch recessed side up, place the sliding clutch on the LO range synchronizer pins.



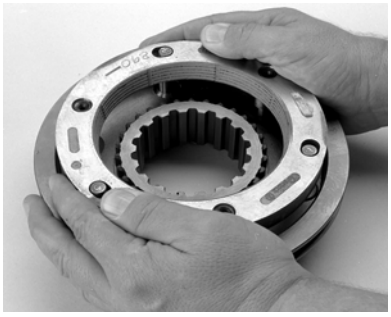


3. In the HI range synchronizer bores, install the three (3) springs.



4. Place the HI range synchronizer ring over the LO range synchronizer ring. Rotate the HI range synchronizer until the springs are seated against the pins.

5. Cover the assembly with a shop rag.



6. Apply downward pressure to the HI range synchronizer ring while twisting counterclockwise. This compresses the springs to fully seat HI range on the LO range synchronizer. This should be done with a rapid twist and push motion.

   Note: Make sure there are three springs and they are fully compressed.

   Note: Make sure you can move the sliding clutch from HI to LO range and back.

How to Assemble the Output Shaft Assembly

Special Instructions

Make sure the magnetic plugs are installed in the auxiliary housing.

Output shaft stack up should be done on a clean, flat surface.

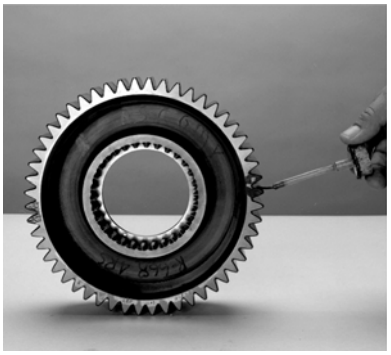
When heating the bearings, do not heat above 275×F (136×C).

When installing the rear bearing race, the proper depth is when the race shoulder is seated on bearing bore top.

Because the collar becomes distorted when compressed, do not use an old nylon collar in the rear bearing cover.

Special Tools

- See Tool Information (see Table 6)
- Toolmaker’s dye
- Heat lamp or hot plate and oil
- Oil seal installation tool



Procedure -

1. Use toolmaker's dye and mark the LO range gear for timing purposes.
2. Mark any two (2) adjacent teeth on the LO range gear. Repeat the procedure for the two (2) adjacent teeth directly opposite the first set marked.

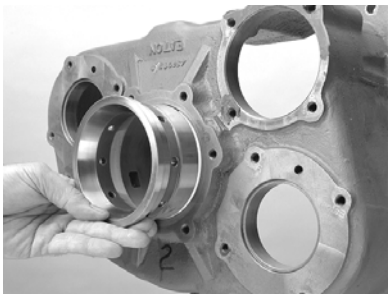
3. With splined washer facing up, place the washer on the output shaft shoulder.

4. With LO range gear clutching teeth down, position LO range gear on the output shaft, engage the washer splines.

5. With chamfer side up, position the LO range gear rear washer on the output shaft against the LO range gear.

6. With tapered side up, use heat or appropriate driver and install the output shaft rear bearing.

7. On the output shaft, position the bearing inner spacer. Set aside.



8. Lay the auxiliary housing front face down on a clean flat surface. Install the bearing race in the bearing bore.

How to Install the Splitter Gear

Special Instructions

Make sure to use an splitter gear retaining bolt with thread sealant material.

The output shaft assembly will need to be placed in a vise in order to tighten the retaining bolt to proper torque.

Applying oil to synchronizer material will ease the installation of the auxiliary section to the main case.

Special Tools

- Vise with brass jaws or wood blocks

Procedure -

1. Lay the output assembly on its side.
2. Submerge synchronizer in motor oil.
3. Install the synchronizer assembly.

4. Install the splitter gear.
5. Install the splitter gear retainer and 15/16" capscrew.
6. Tighten the splitter gear retainer bolt to 190-210 Lb•ft of torque.

   Note: Make sure the splitter gear retainer bolt is properly torqued.

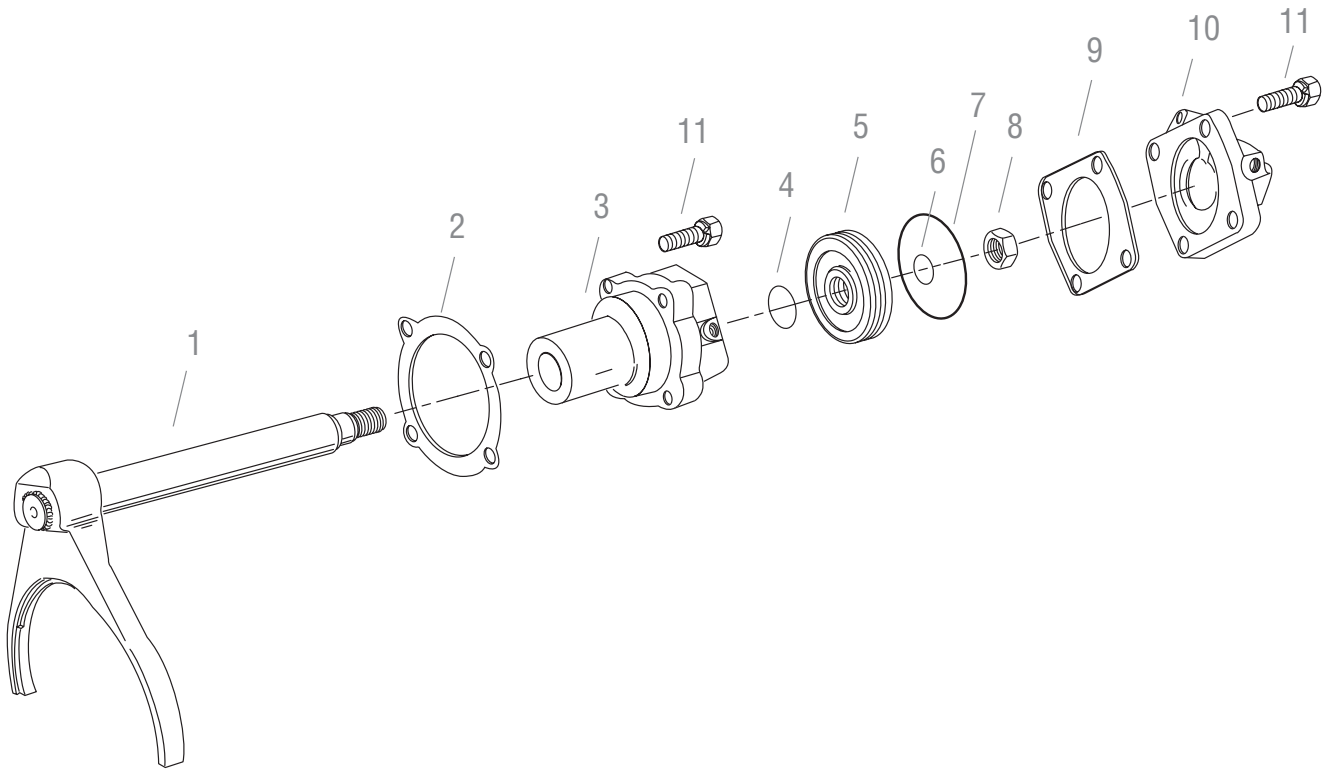
How to Assemble the Range Cylinder Assembly

Special Instructions

Apply Eaton lubricant #71214 or equivalent to shift cylinder assembly and insert valve O-rings so a film covers the entire surface of each O-ring.

Special Tools

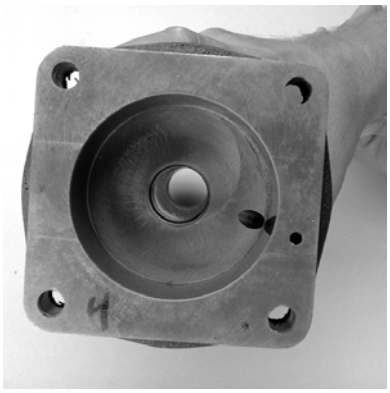
- Typical service tools



1. Yoke Bar
2. Gasket
3. Range Cylinder Assembly
4. O-Ring
5. Piston
6. O-Ring
7. O-Ring
8. Nut
9. Gasket
10. Cover
11. Capscrew

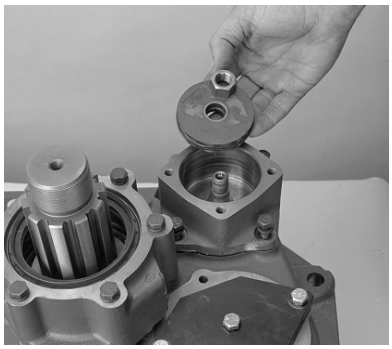
Procedure -

1. If previously removed, in the cylinder housing bore, install the small O-ring.

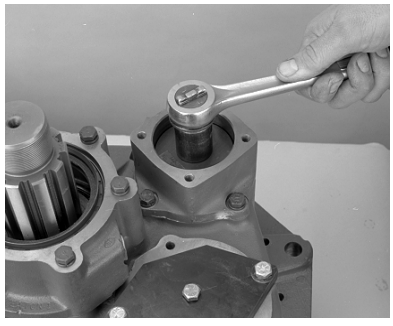


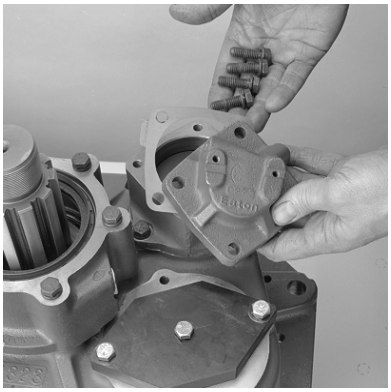
2. If previously removed, on the piston I.D. and O.D., install the piston O-rings.

3. Position a new gasket on the range cylinder housing mounting surface.
4. Install the cylinder housing.
5. Apply Eaton/Fuller sealant #71205 or equivalent to the retaining capscrews.
6. Install the capscrews, tighten to 20-25 Lb•ft of torque.
7. Lean auxiliary section back with range cylinder upward.
8. Insert the piston. Push it in as far as it will go.



9. Secure the piston with the retaining nut, tighten to 70-85 Lb•ft of torque.





10. Position a new gasket on the cylinder housing cover mounting surface.

11. Over the gasket, position the range cylinder cover.

12. Apply Eaton/Fuller sealant #71205 or equivalent to the retaining capscrews.

13. Install the capscrews, tighten to 20-25 Lb•ft of torque.

How to Install Splitter Cylinder Assembly

Special Instructions

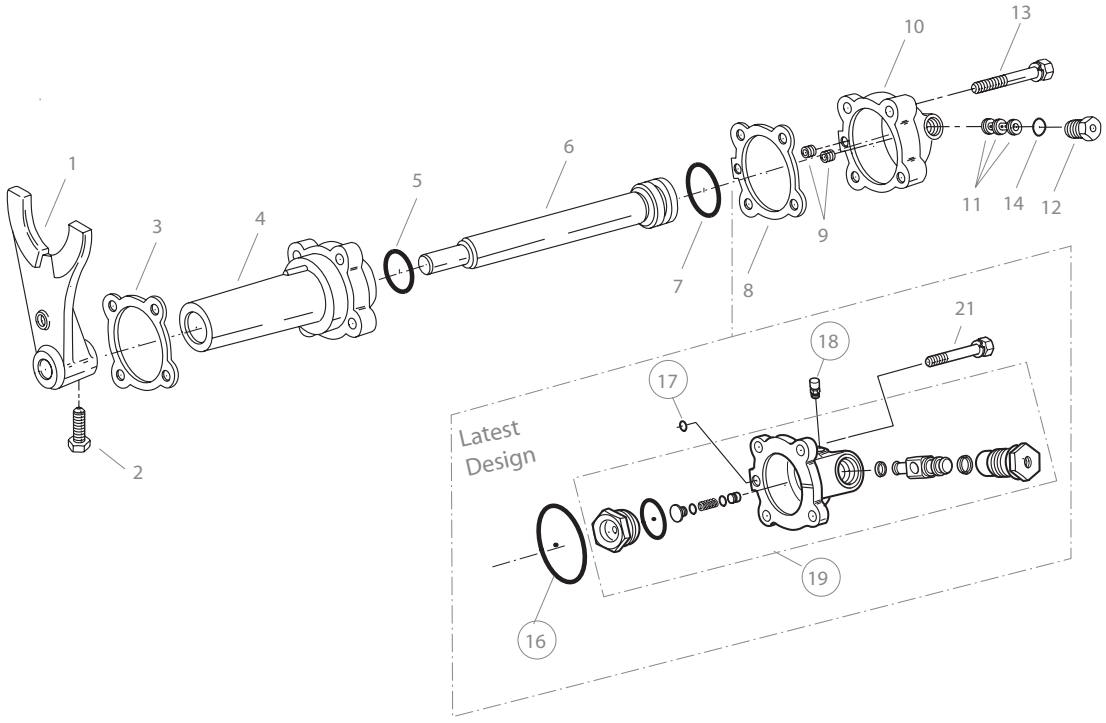
Apply Eaton lubricant #71214 or equivalent to all shift cylinder assembly and spool valve O-rings so a film covers the entire surface of each O-ring.

Apply Eaton rust preventative #71213 or equivalent to all shift cylinder walls and yoke bars and cover the entire yoke bar surface that comes in contact with the shift cylinder O-ring.

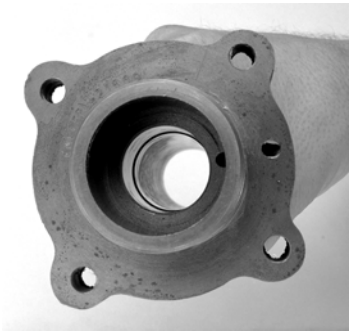
Auxiliary case is installed after the splitter piston and housing.

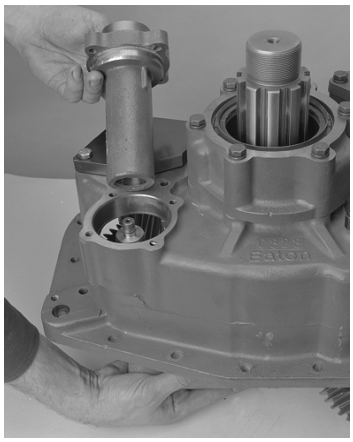
Special Tools

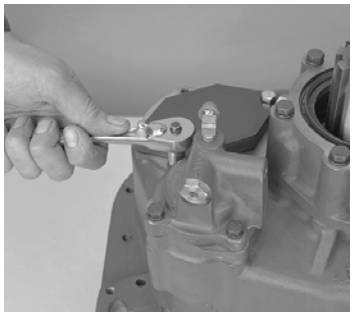
- Typical service tools
- Vise with brass jaws or wood blocks



1. Shift Yoke
2. Lockscrew
3. Gasket
4. Splitter Cylinder
5. O-Ring
6. Yoke Bar
7. O-Ring
8. Gasket
9. Plug
10. Cover
11. Insert Valve
12. Reducer Bushing
13. Capscrew
14. O-Ring
16. O-Ring
17. O-Ring
18. Breather
19. Splitter Valve Kit
21. Capscrew







Procedure -

1. If previously removed, in the cylinder housing bore, install the small O-ring.
2. If previously removed, on the piston O.D., install the piston O-ring.
3. Position a new gasket on the cylinder housing mounting surface.
4. With the air passage towards the rear bearing cover, install the cylinder housing.
5. Inside the cylinder housing, over the yoke bar end, install the O-ring.
6. Install the splitter piston.
7. Install the splitter yoke retaining bolt and lockwire. Tighten to specification.
8. Install the Auxiliary case (Use How to Install the Auxiliary Section procedure).
9. Position a new gasket or O-ring (new design, aluminum cover) on the cylinder housing cover mounting surface. The gasket air passage must align with the housing air passage.
10. Position the splitter cylinder cover over the gasket or O-ring (new design, aluminum cover).
11. Apply Eaton/Fuller sealant #71205 or equivalent to the retaining capscrews.
12. Install and tighten the retaining capscrews to 20-25 Lb•ft of torque.
13. Refill transmission with lube to the proper level.

Note: Make sure the retaining nut and capscrews are tightened to the proper torque.

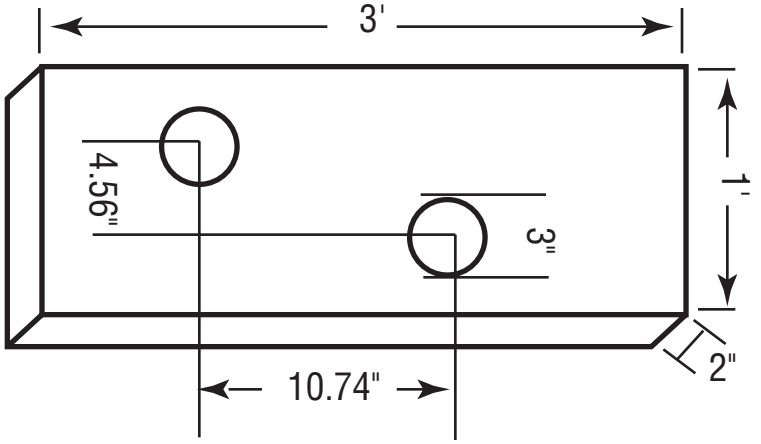
Note: Make sure gaskets are used at appropriate positions.

How to Install the Countershaft Assemblies (w/Tapered Bearings)

Special Instructions

For "A" Series, go to “A” Series Section.

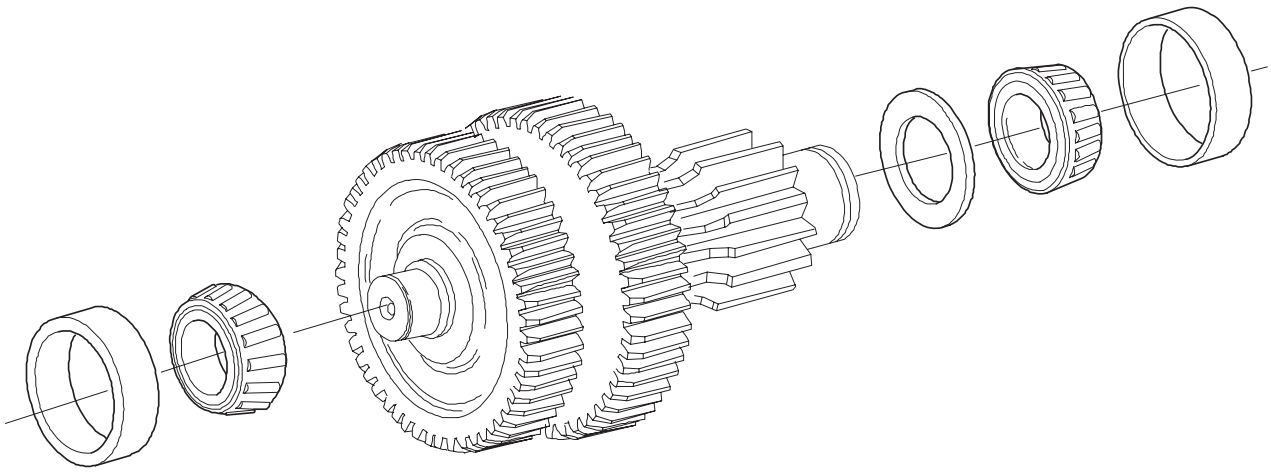
To make auxiliary section assembly easier, you can make an auxiliary section fixture out of a 2" x 12".



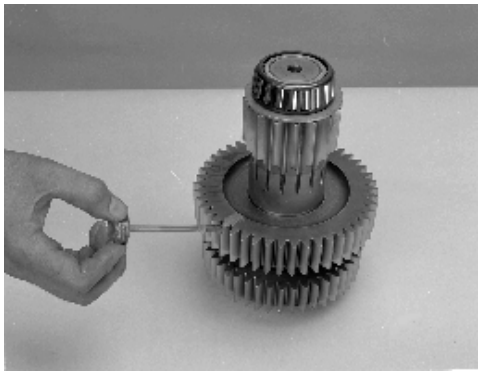
Make sure to use an auxiliary drive gear retaining bolt with thread sealant material.

Special Tools

- Typical service tools
- Auxiliary countershaft retaining straps
- Toolmaker’s dye

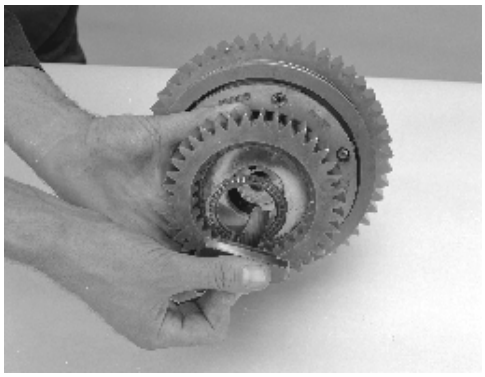


Procedure -



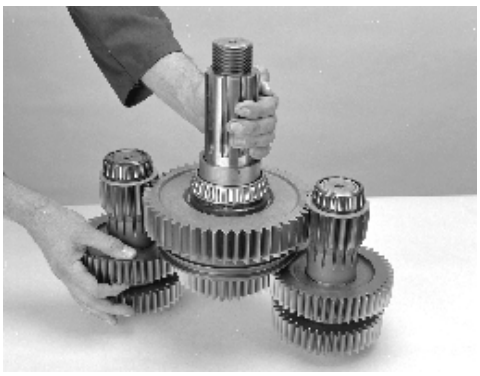
1. Place the countershaft assembly vertical on a clean, flat surface. If previously removed, use the proper driver and maul to install the countershaft bearings.

2. Mark each countershaft for correct timing. Locate the "O" stamped on the countershaft and mark the tooth with highly visible toolmaker's dye or paint.



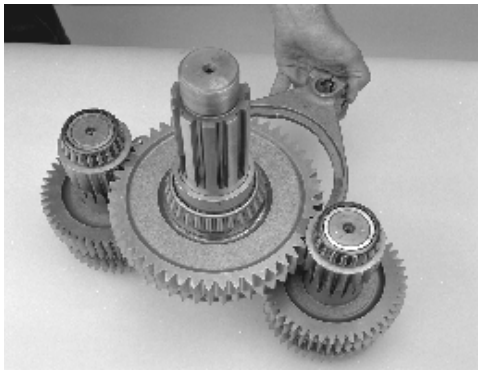
3. Install the synchronizer assembly on output shaft front.

4. Place the thrust washer, the rear auxiliary drive gear, the thrust washer, the retainer and the 15/16" capscrew on the output shaft assembly. Finger tighten the capscrew.



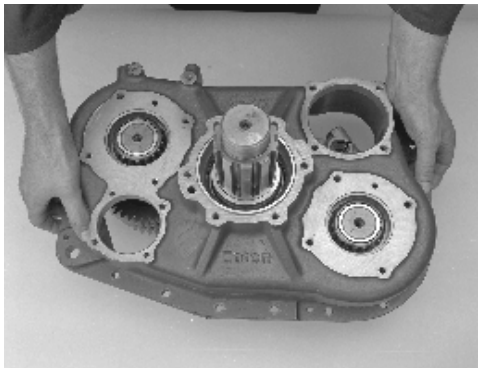
5. Place the countershafts in the fixture or on a flat surface for reassembly. Turn the countershafts so that the two teeth marked on each LO range gear are towards the middle.

6. Align the output shaft between the countershafts, match the timing marks.



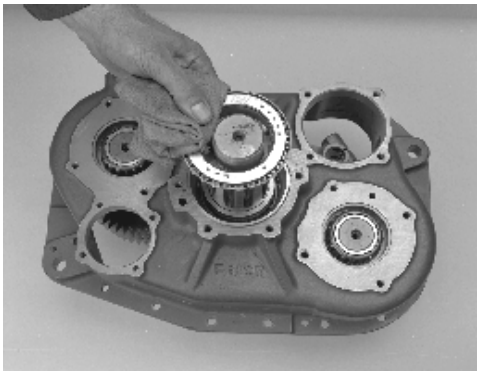
7. With range yoke offset side facing down, install into the synchronizer sliding slot.

8. Place the auxiliary housing over the countershaft assemblies and the output shaft assemble.



9. Heat the rear output bearing cone and install the bearing, tapered side down, on the shaft.

10. Position a new gasket on the rear bearing cover mounting surface.

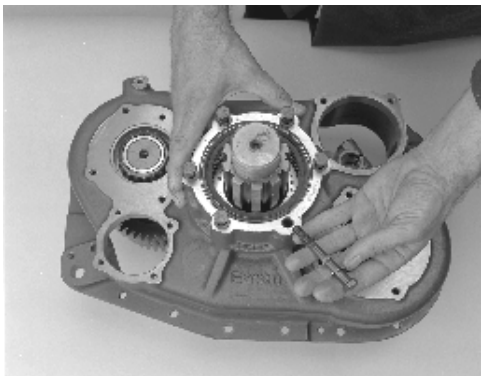


11. Position the rear bearing cover.

12. Apply Eaton/Fuller Sealant #71205 or equivalent to the retaining capscrews.

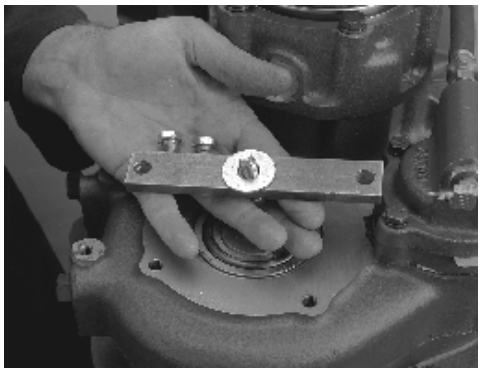
13. Install the five (5) retaining capscrews in the non-chamfered hole, tighten to 35-45 lb-ft of torque.

14. Install the nylon collar and brass washer in the chamfered hole, tighten to 35-45 lb-ft of torque.



15. Install each auxiliary countershaft retaining strap with 2 - 3/8" NC x 1" and 1 - 3/8" NC x 2 -1/2" clean capscrews.

WARNING: Do not use an air gun. Tighten by hand until the capscrews are snug.



How to Install the Countershaft Assemblies (w/Ball Bearings) A Series

Special Instructions

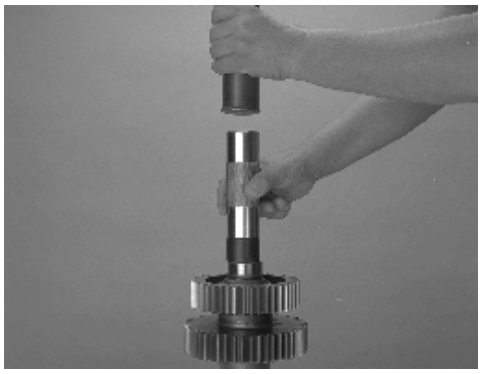
For ease of assembly, mount the auxiliary section in a vise.

When Installing the countershaft assemblies into the countershaft bearings, keep the countershaft assemblies straight. Do not cock the countershafts.

If, when the countershaft bearing cover is removed and you can not see the snap ring groove, install the cover and drive the countershaft further until you can see the groove.

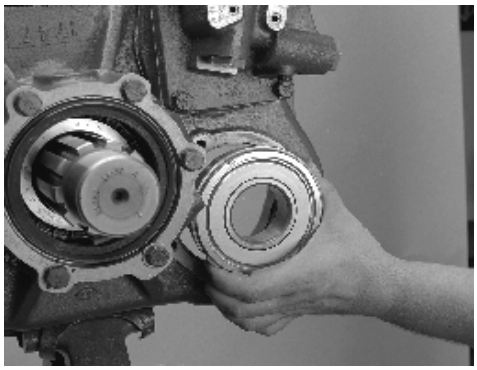
Special Tools

- Typical Service Tools
- Vise with brass jaws or wood blocks
- Bearing driver and a maul
- Toolmaker's dye
- Large snap ring pliers



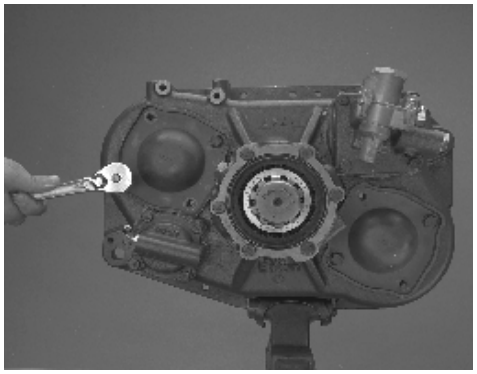
Procedure -

1. Place the countershaft assembly vertical on a clean, flat surface. If previously removed, using the proper driver and maul install the countershaft bearing race.

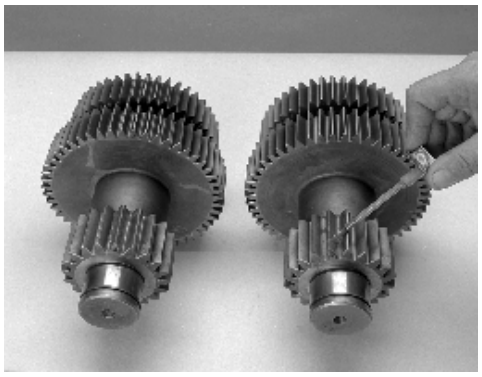


2. In the countershaft rear bearing bore, using the proper driver and maul, install the countershaft bearing.

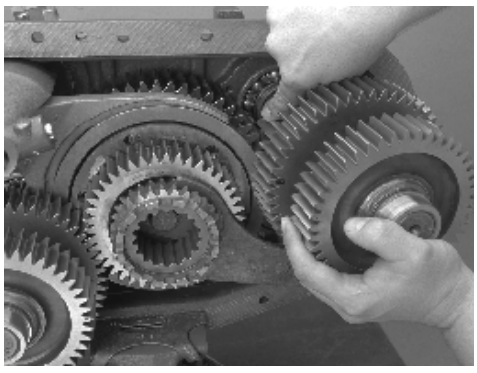
3. Temporarily install the rear bearing cover, use two (2) capscrews and no gasket. The cover holds the bearing as the countershaft is driven into the bearing.



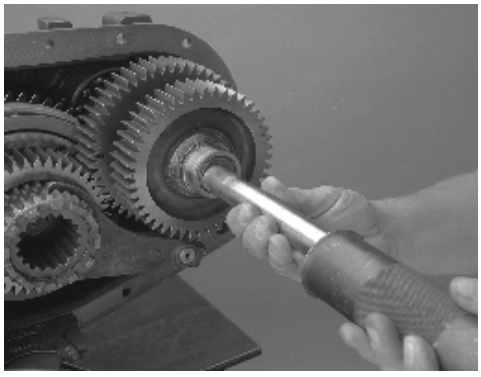
4. Use toolmaker's dye and mark the smaller LO range gear tooth that aligns with countershaft gear marked with an "O".

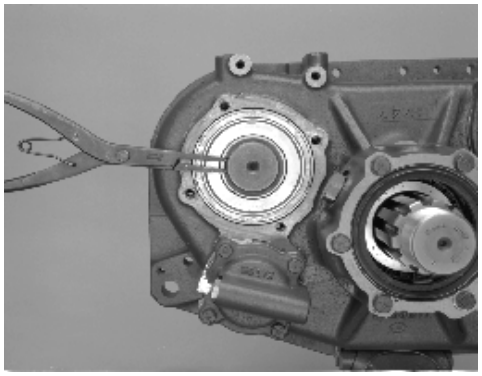


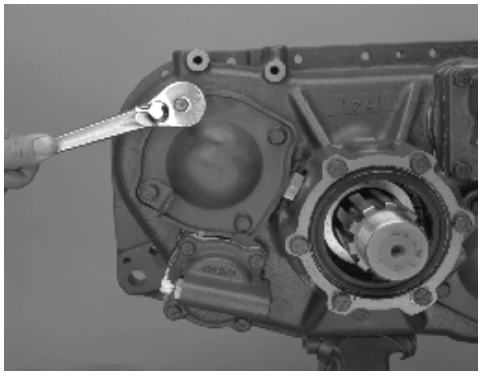
5. Position the countershaft in the auxiliary housing. Mesh the countershaft marked tooth with either set of LO range gear marked teeth.



6. Use a sort bar and maul and drive the countershaft into the countershaft bearing.







7. From the auxiliary housing rear, remove the countershaft bearing cover and install the rear countershaft snap ring in the snap ring groove.

8. Position a new gasket on the countershaft bearing cover mounting surface.

9. Position the countershaft bearing cover over the gasket.

10. Apply Eaton/Fuller sealant #71205 or equivalent to the retaining capscrews.

11. Install the capscrews, tighten to 35-45 lb-ft of torque.

12. Repeat all steps for other countershaft installation.

Final Check

- Check both countershafts for timing; the output shaft should rotate freely.
- Check capscrews for proper torque.

How to Remove the Clutch Housing

Special Instructions

Removal of the clutch housing is done in the horizontal position.

The clutch release mechanism must be removed.

Some early production models do not have an oil tube behind the clutch housing. For these models, skip step 5.

Special Tools

- Typical service tools

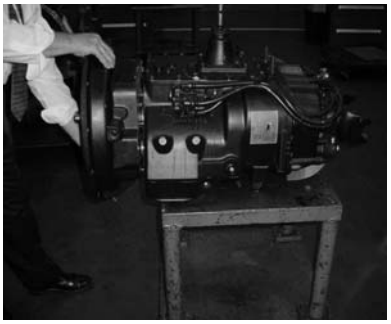
Procedure -

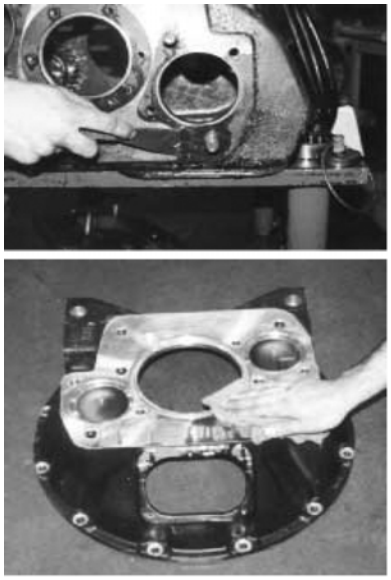
1. From inside the clutch housing, remove the nuts and washers.

2. From inside the clutch housing, remove the bolts.

3. Jar clutch housing to break gasket seal.

4. Pull the clutch housing from the studs and transmission case.





5. Remove the gasket and clean all mounting surfaces of gasket material.

How to Remove the Auxiliary Drive Gear Assembly

Special Instructions

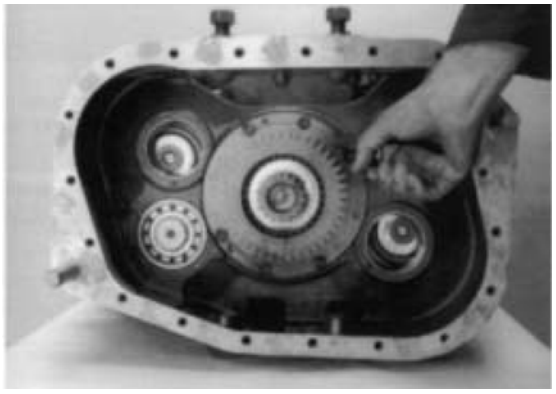
Before removing the auxiliary drive gear, the auxiliary section must be removed.

Special Tools

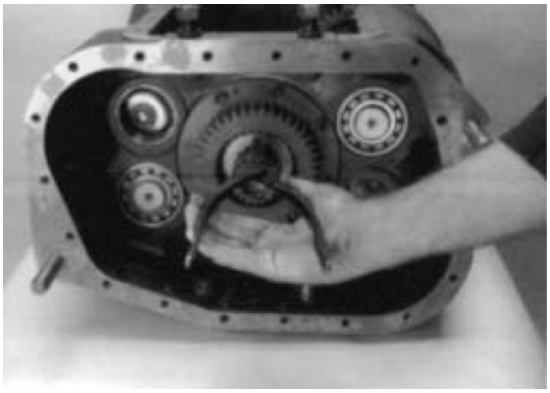
- Large pair of snap ring pliers

Procedure -

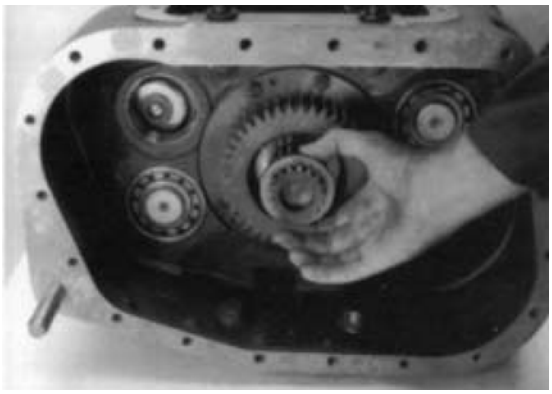
1. Cut lockwire from auxiliary bearing retainer ring capscrews.

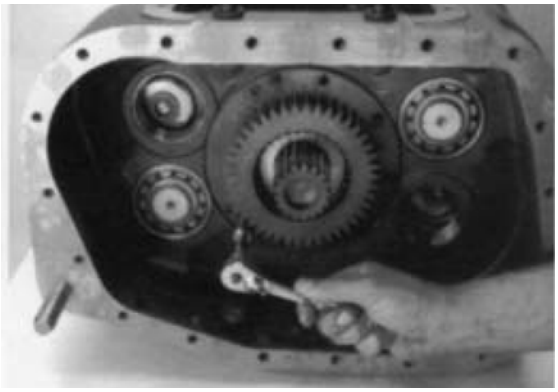


2. Remove snap ring from mainshaft rear groove.

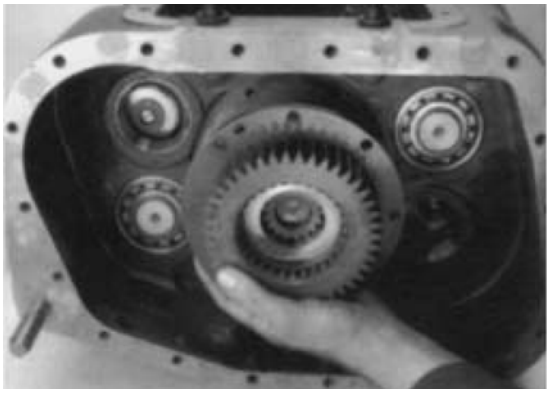


3. Remove the splined washer from inside front auxiliary drive gear assembly.

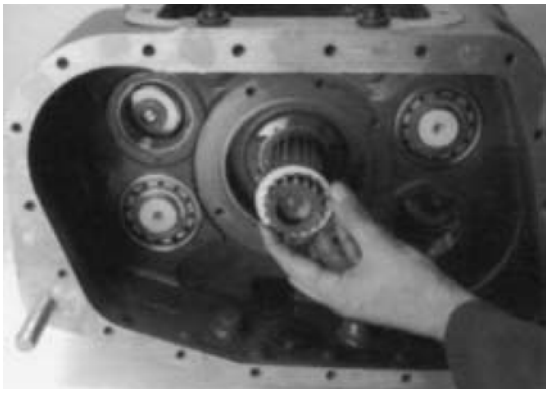




4. Remove six capscrews from the auxiliary bearing retainer ring. Insert three puller screws in the specially tapped holes of retainer ring. Tighten screws evenly to pull the front auxiliary drive gear assembly from case bore.



5. Remove front auxiliary drive gear from mainshaft.



6. Remove the splined washer from the mainshaft also remove the front auxiliary drive gear retaining snap ring from the mainshaft.

How to Disassemble the Upper Reverse Idler Gear Assembly

Special Instructions

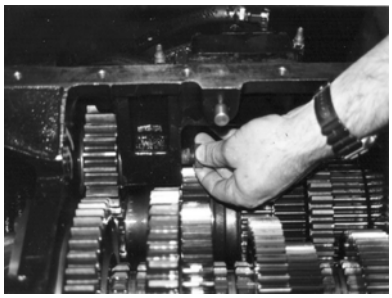
Before the upper reverse idler gear assembly can be removed, mainshaft reverse gear must be positioned forward against the next gear.

While removing the reverse idler shaft, the thrust washer can drop to the transmission case bottom.

The mainshaft reverse gear must be moved in order to remove the upper reverse idler gear.

Special Tools

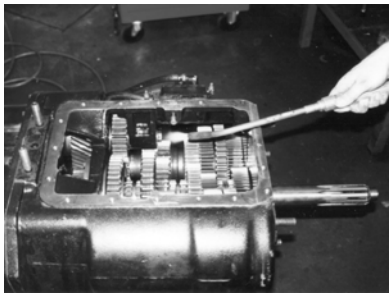
- Typical service tools
- Jaw pullers or impact puller
- Soft bar and maul



Procedure -

1. Remove retaining bolt from the Idler Shaft.

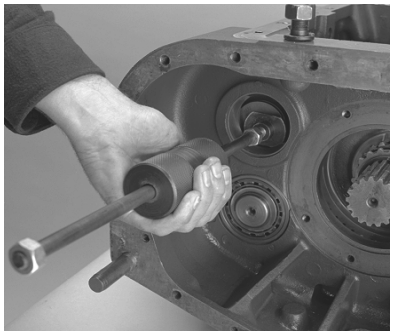
   Note: If Idler Shaft spins in case bore, slightly heat bolt with torch to release loctite adhesive.



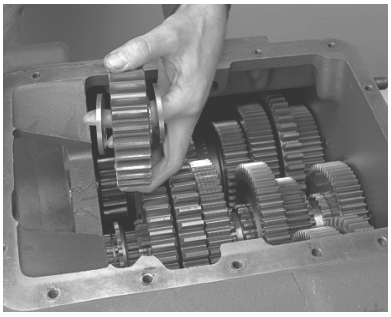
2. The mainshaft reverse gear must be moved in order to remove the upper reverse idler gear. Remove reverse gear snap ring and slide reverse gear forward over clutch.

3. Remove the loosened bolt and remove washer. Reinstall bolt 3–4 threads.

4. Install an impact puller, 1/2”-13 threaded end, and remove the shaft from case bore.



5. As the idler shaft and idler plate are removed, remove the thrust washers and gear.



6. Inspect the reverse gear assembly, remove the inner race and needle bearing, if damaged.

How to Remove the Upper and Lower Countershaft Bearings

Special Instructions

The following instructions are used to remove the upper and lower countershaft bearings. To remove the mainshaft assembly, only the upper countershaft bearings need to be removed.

Performing the following instructions will damage the bearings and should be not be done unless bearing replacement is planned.

The bearing inner race remains pressed on the countershaft after removal of the front bearings.

Special Tools

- Soft bar and maul
- Item T8: Countershaft Pusher
- Item T9: Bearing Puller

Procedure -

1. To keep the mainshaft pilot from falling out of the input shaft pocket, temporarily install the auxiliary drive gear on the mainshaft.

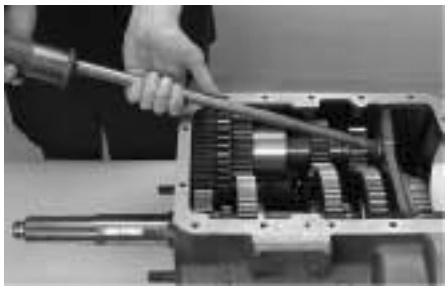
2. From each countershaft rear groove, remove the snap ring.

3. Remove six capscrews from front bearing cover and remove front bearing cover.

⚠ CAUTION

Damage will likely occur to this bearing during removal. It is strongly recommended that this bearing is discarded.

4. From inside the case, use a soft bar and maul to drive the countershaft rear bearings rearward off the shaft.



5. From the front of each countershaft, remove the capscrew and front retainer plate.

6. Use the soft bar and maul to drive each countershaft to the rear as far as possible. This partially unseats the front bearings.

7. Return to the case rear, and drive each countershaft forward as far as possible. This exposes the external snap ring.

8. Use the appropriate bearing puller T9 or prybars to remove the countershaft front bearings.

How to Remove the Mainshaft Assembly

Special Instructions

None

Special Tools

- See Tool Information (see Table 6)
- Item T15: Mainshaft hook

Procedure -

1. Secure the upper countershaft to the side and away from the mainshaft. Optional: Insert prybar between upper countershaft and main drive gear as shown.

2. Insert the mainshaft hook tool or rope around the mainshaft.

   Note: Keep the upper countershaft forward against the case front wall.

⚠ WARNING

Be careful when removing the mainshaft assembly. The sliding clutch on the front and the reverse gear on the back can slip off the shaft.

3. Pull the mainshaft to the rear to free the pilot from the input shaft pocket.

4. Tilt the mainshaft front up and lift the assembly from the case.

How to Remove the Countershaft Assemblies

Special Instructions

Except for the PTO gears, the upper and lower countershaft assemblies are the same. Mark the countershafts as UPPER or LOWER as you remove them.

The mainshaft and main drive gear must be removed before removing the countershaft assemblies.

Special Tools

- Typical service tools

Procedure -

1. Mark the countershafts as UPPER or LOWER as you remove them.

   Note: The mainshaft and main drive gear must be removed before removing the countershaft assemblies.

2. Remove the rear snap ring from the rear upper countershaft bearing.

3. From inside the case, use a long soft bar to drive the upper countershaft rear bearing rearward off the shaft.

   Note: Damage will likely occur to this bearing during removal. It is strongly recommended that this bearing is discarded.

4. Remove the capscrew and the retainer from the upper countershaft front.

5. Slide the lower countershaft forward. This will move the front bearing forward to expose the external snap ring.

6. Use the appropriate bearing puller (Tool ID T6) or two prybars to remove the lower front bearing from its bore.

7. Move the upper countershaft to the rear until the front bearing journal clears the front case bore.

8. Swing the front of the countershaft to the center of the case, and lift out the countershaft assembly.

Note: A large hook or piece of rope may help support the countershaft.

Note: Follow the same procedure for lower countershaft removal.

How to Disassemble the Countershaft Assemblies

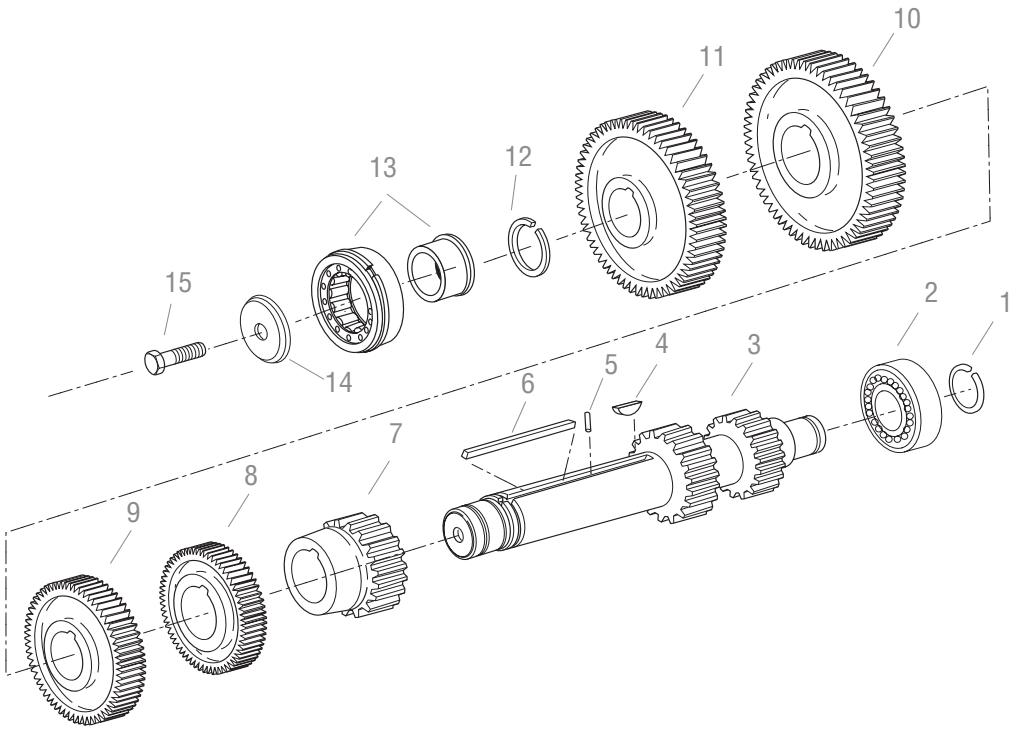
Special Instructions

As you disassemble the countershafts, mark each part as belonging to the upper or lower countershaft and mark the gears for front or back orientation.

Except for the PTO gears, the left and right countershaft assemblies are identical and disassembled in the same manner.

Special Tools

- See Tool Information (see Table 6)
- Snap ring pliers
- Press



10364-11-96 CS/RT

1. Snap Ring
2. Bearing
3. Countershaft with Reverse and LO
4. Key
5. Roll Pin
6. Key
7.Gear
8. Gear
9. Gear
10. PTO Gear
11. Drive Gear
12. Snap Ring
13. Bearing
14. Retainer Kit
15. Capscrew

Procedure -

⚠ CAUTION

NEVER USE THE PTO GEAR AS A PRESSING BASE. The narrow face width of this gear makes it very susceptible to breakage

1. Remove the front countershaft snap ring.

2. Place the countershaft in the press as shown. Using the rear face of 3rd/Overdrive speed gear as a base, press the drive gear, PTO gear, and 3rd/Overdrive speed gear from each countershaft. This removes the front bearing inner race from the countershaft.

3. Position the countershaft in the press as shown. Press the next two gears from the shaft.

4. Inspect the keys and roll pin. Remove and replace if damaged.

How to Remove the Input Shaft and Main Drive Gear

Special Instructions

None

Special Tools

- See Tool Information (see Table 6)
- Item T16: Bearing puller
- Soft bar and maul

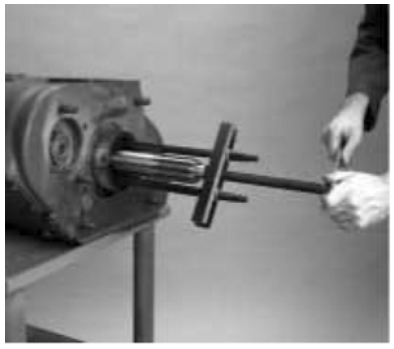
Procedure -

1. From the front bearing cover, remove the six (6) retaining capscrews and cover. Remove any remaining gasket material from the case and cover.

2. If present, remove and discard the rubber seal ring on the input shaft. The ring is used only to seal the transmission during shipment.

3. From the input shaft groove, remove the bearing retaining snap ring.

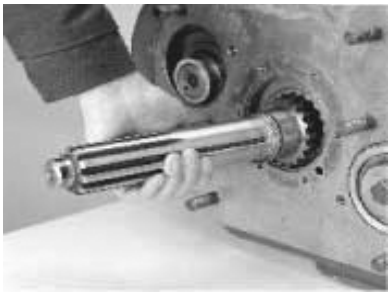
4. Use a soft bar and maul to drive the input shaft toward the case rear as far as possible. Pull the input shaft forward.



5. Install the bearing puller tool and remove the input bearing from the case and input shaft or use pry bars or screwdrivers to complete removal of the bearing.

6. From the drive gear front, remove drive gear spacer.

7. Remove the drive gear internal snap ring.



8. Pull the input shaft forward and out of the drive gear.
9. From inside the case, remove the drive gear.

10. Inspect the bushing in the input shaft pocket, replace if damaged.

How to Prepare the Main Case for Assembly

Thoroughly clean case of metal particles. Remove the gasket material from flange surfaces. Inspect flange surfaces for damage. Inspect bearing bores for damage or excessive wear. Replace as necessary.

If necessary, replace any damaged or worn clutch housing or rear support studs. Apply Eaton® Fuller® thread sealant #71205 or equivalent to any replacement studs before installing them.

Verify the three magnetic discs are firmly attached to the bottom of the main case. If they are not firmly attached, apply 3M scotch grip or equivalent adhesive to the bottom of the discs and attach them to the main case.

How to Disassemble the Mainshaft Assembly

Special Instructions

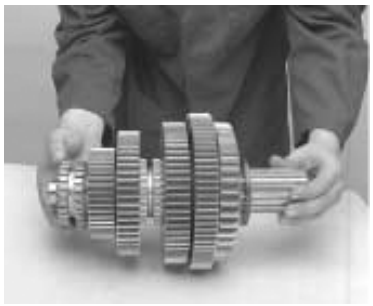
Lay all parts on a clean bench in order of removal to facilitate assembly.

Special Tools

- Typical service tools

Procedure -

1. Lay the mainshaft on its side, and from the front, remove the 4th (or overdrive) and 5th sliding clutch.



2. Place the mainshaft in a vertical position, pilot end down.
3. Remove snap ring (if applicable).

4. Remove key, washer, and reverse gear. Mark keyway location.

   Note: When removing washer and reverse gear, note their orientation. Keep the washer with the reverse gear.

5. Remove the 1st and reverse sliding clutch.

6. Remove the offset washer and 1st gear.
7. Remove the flat washer and 2nd gear.

8. Remove the offset washer and sliding clutch.
9. Remove the offset washer and 3rd gear.
10. Remove the flat washer.

11. Remove the 4th or overdrive gear.
12. Remove the offset washer.

How to Assemble the Mainshaft Assembly with Selective (Adjustable) Thickness Tolerance Washers

Special Instructions

There are three distinct mainshaft washer and mainshaft key designs. They are (listed from oldest design to newest design):

a. Six (6) sided mainshaft key with selective (adjustable) thickness tolerance washers.

b. Three (3) sided mainshaft key with selective (adjustable) thickness tolerance washers.

c. Three (3) sided mainshaft key with non-selective (non-adjustable) tolerance washers.

Note: Between 1993 and 1996, some models were produced with a mixture of selective thickness washers and non-selective tolerance washers on the same mainshaft.

Note: The proper mainshaft key must always be used with the proper design mainshaft washers. If necessary, refer to the parts manual for your specific model to confirm the proper parts.

Note: Previous design levels can be updated to the current design.

Each mainshaft gear must have its inside snap ring installed before placement on the mainshaft. Do not install reverse gear inside snap ring at this time.

Gear tolerance washers are internally splined and locked to the mainshaft by the key. Gear spacers are externally splined to engage with gear hub clutching teeth. There is one tolerance washer and one spacer for each mainshaft gear.

Axial clearance (end-play) limits are 0.006"-0.015" for all mainshaft gears.

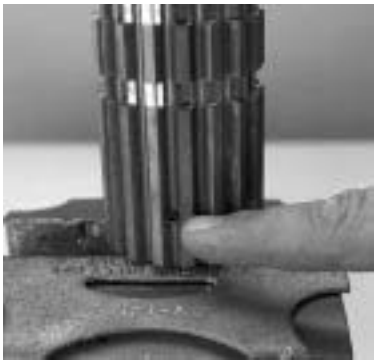
If the axial clearance is less than the minimum 0.006" tolerance, the tolerance washer should be replaced with a thinner tolerance washer. This will increase the axial clearance between the gears. If the axial clearance is greater than the maximum 0.015" tolerance, a thicker tolerance washer should be installed. This will decrease the axial clearance between the gears.

If necessary, refer to the parts manual for your specific transmission model to determine the correct position of each mainshaft gear.

The mainshaft you are using may have 3 grooves in certain gear positions. The middle groove is not used with the selective washer design.

Special Tools

- A piece of 5/32" air line, 1' long
- Vise with brass jaws



Procedure -

1. With mainshaft pilot-end down, secure the mainshaft in a vise equipped with brass jaws or wood blocks.

2. If previously removed, install the roll pin in keyway.

3. With the washer flat side up, position a gear tolerance washer (white) in the mainshaft 1st or bottom groove. Rotate the washer until the washer splines and mainshaft splines align.

4. Start at the mainshaft bottom and install a 1/8” or 5/32” diameter plastic line in the keyway to lock the washer in place. As limit washers and gears are installed, continue to push the plastic line up.

5. Against the 4th speed gear washer, position a spacer washer against the tolerance washer.

6. With clutching teeth down and engaged with the spacer external splines, position the proper gear on the mainshaft. If necessary, refer to the illustrated parts list to determine gear order.

7. With clutching teeth up and against this gear, install the next gear and spacer washer.

8. With the washer flat side down, position a tolerance washer against the spacer. Rotate the washer until the washer splines and mainshaft splines align.

9. Push the air line up to lock the washer on the mainshaft.

10. Insert two large screwdrivers between the two gears. Apply slight downward pressure to spread the gears evenly. Between the gear hub and mainshaft spacer, insert 0.006" feeler gauge and 0.015" feeler gauge. If out of tolerance, change the washer against the mainshaft spacer.

11. With the missing internal splines aligned with the plastic line, install a sliding clutch.

12. With the washer flat side up, position tolerance washer (white) in the next available groove. Rotate the washer until the washer splines and mainshaft splines align.

13. Push the air line up to lock the washer on the mainshaft.

14. Install a gear spacer.

15. With clutching teeth down, position the next gear on the mainshaft engaging with spacer external splines.

16. With clutching teeth up, install the next gear on shaft against the previously positioned gear.

17. Position another spacer against the previously positioned gear, engaging the spacer external splines with gear clutching teeth.

18. With washer flat side down, position the tolerance washer against the spacer. Rotate the washer until the washer splines and mainshaft splines align.

19. Push the air line up to lock the washer on the mainshaft.

20. Insert two large screwdrivers between the two gears. Apply slight downward pressure to spread the gears evenly. Between the gear hub and mainshaft spacer, insert 0.006" feeler gauge and 0.015" feeler gauge. If out of tolerance, change the washer against the mainshaft spacer. Refer to information before stepped procedures for further information.

21. Align the sliding clutch missing internal spline with the mainshaft key and install the reverse speed sliding clutch.

22. With the flat side up, place a washer (blue or white) in the next available groove. Rotate the washer until the washer splines and mainshaft splines align.

23. Push the air line up to lock the washer on the mainshaft.

24. Against the tolerance washer, position reverse speed gear spacer.

25. Install reverse gear on the mainshaft. Engage the gear clutching teeth with spacer external splines and sliding clutch. Move the reverse gear down against the 1st speed gear.

26. At this time remove the air line and insert the mainshaft key. Be careful not to move the gears while doing this procedure, the tolerance washers are unlocked and can rotate which would cause the gears to drop.

27. Remove the mainshaft from the vise.

28. On the shaft front, align the sliding clutch missing internal spline with the mainshaft key and install the front sliding clutch. Engage the sliding clutch external splines with the gear clutching teeth.

Washers for 6-Sided Key

PART	SIZE	COLOR
14711	0.248-0.250	White
14712	0.253-0.255	Green
14713	0.258-0.260	Orange
14714	0.263-0.265	Purple
14715	0.268-0.270	Yellow
14716	0.273-0.275	Black

Washers for 3-Sided Key

PART	SIZE	COLOR
4300830	0.244	Blue-Light Blue
4300382	0.249	White-Light Blue
4300383	0.254	Green-Light Blue
4300384	0.259	Orange-Light Blue
4300385	0.264	Purple-Light Blue
4300386	0.269	Yellow-Light Blue
4300387	0.274	Black-Light Blue

How to Assemble the Mainshaft Assembly with Non-Selective (Non-Adjustable) Tolerance Washers

Special Instructions

The proper mainshaft key must always be used with the proper design mainshaft washers. If necessary, refer to the parts manual for your specific model to confirm the proper parts.

Previous design levels can be updated to the current design.

Special Tools

- A piece of 5/32" air line, 1" long
- Vise with brass jaws

Procedure -

1. With mainshaft pilot-end down, secure the mainshaft in a vise equipped with brass jaws or wood blocks.

2. If previously removed, install the roll pin in keyway.

3. With mainshaft pilot-end down, install offset washer (flat surface up). Rotate the washer until the washer splines and mainshaft splines align.

4. Start at the mainshaft bottom and install a plastic line in the marked keyway to lock the washer in place.

5. With clutching teeth down, position the proper gear on the mainshaft. Refer to the illustrated parts list for correct gear.

6. Install the flat washer. Rotate the washer until the washer splines and mainshaft splines align.

7. With clutching teeth up and against the spacer, install the next gear.

8. Position the offset washer (flat surface down) against the gear. Rotate the washer until the washer splines and mainshaft splines align.

9. Push the air line up to lock the washers on the mainshaft.

10. With the missing internal splines aligned with the plastic line, install the proper sliding clutch.

11. Position the next offset washer in the next available groove. Rotate the washer until the washer splines and mainshaft splines align.

12. Push the air line up to lock the washer on the mainshaft.

13. With clutching teeth down, position the next proper gear on the mainshaft.

14. Position the flat washer against the gear. Rotate the washer until the washer splines and mainshaft splines align.

15. With clutching teeth up, install next gear on the shaft against previously installed gear.

16. Position the offset washer (flat surface down) against the gear. Rotate the washer until the washer splines and mainshaft splines align.

17. Push the air line up to lock the washer on the mainshaft.

18. With the missing internal splines aligned with the plastic line, install the reverse sliding clutch.

19. Install the reverse gear offset washer in the last groove.

20. From the mainshaft rear, install the mainshaft key into the spline with the air line. Pull the air line from the spline while installing the key.

21. Install the reverse gear spacer washer (with external spline teeth) over the mainshaft rear and against the offset washer.

    Note: Some models, the reverse gear offset washer has a large chamfer machined in the backside. This special offset washer must be used in this position. The large chamfer faces rearward.

22. From the rear, install the reverse gear over the sliding clutch teeth.

23. Install the snap ring in the mainshaft groove.

    Note: Some models do not use a snap ring at this position.

24. Remove the mainshaft from the vise and lay on its side.

25. Install the front sliding clutch into position.

How to Assemble the Countershaft Assemblies

Special Instructions

Except for the PTO gears, the upper and lower countershaft assemblies are the same. To avoid confusion during installation, mark the upper countershaft (45-tooth PTO gear) with an "U". The lower countershaft has a 47-tooth PTO gear.

Special Tools

- Snap ring pliers
- Press

Procedure -

1. If previously removed, install the keys in each countershaft keyway.

2. Align smallest diameter gear keyway with the countershaft key, long hub to countershaft front, and press the gear on the countershaft.

3. Align 2nd smallest diameter gear keyway with the countershaft key, long hub against 1st speed gear, and press the gear on the countershaft.

4. Align 3rd smallest diameter gear keyway with the countershaft key, long hub to countershaft front, and press the gear on the countershaft.

5. Align PTO gear keyway with the countershaft key, bullet-nose of teeth facing up (shaft rear). Align drive gear keyway with the countershaft key, long hub against PTO gear, and press both gears on the countershaft.

6. On each countershaft front, install the drive gear retaining snap ring in groove.

7. Use a flanged-driver or the press to install the bearing inner race on the countershaft front against the drive gear.

   Note: Make sure all gears are pressed into place.

   Note: Make sure the bearing inner race is installed.

How to Assemble the Lower Reverse Idler Gear Assembly

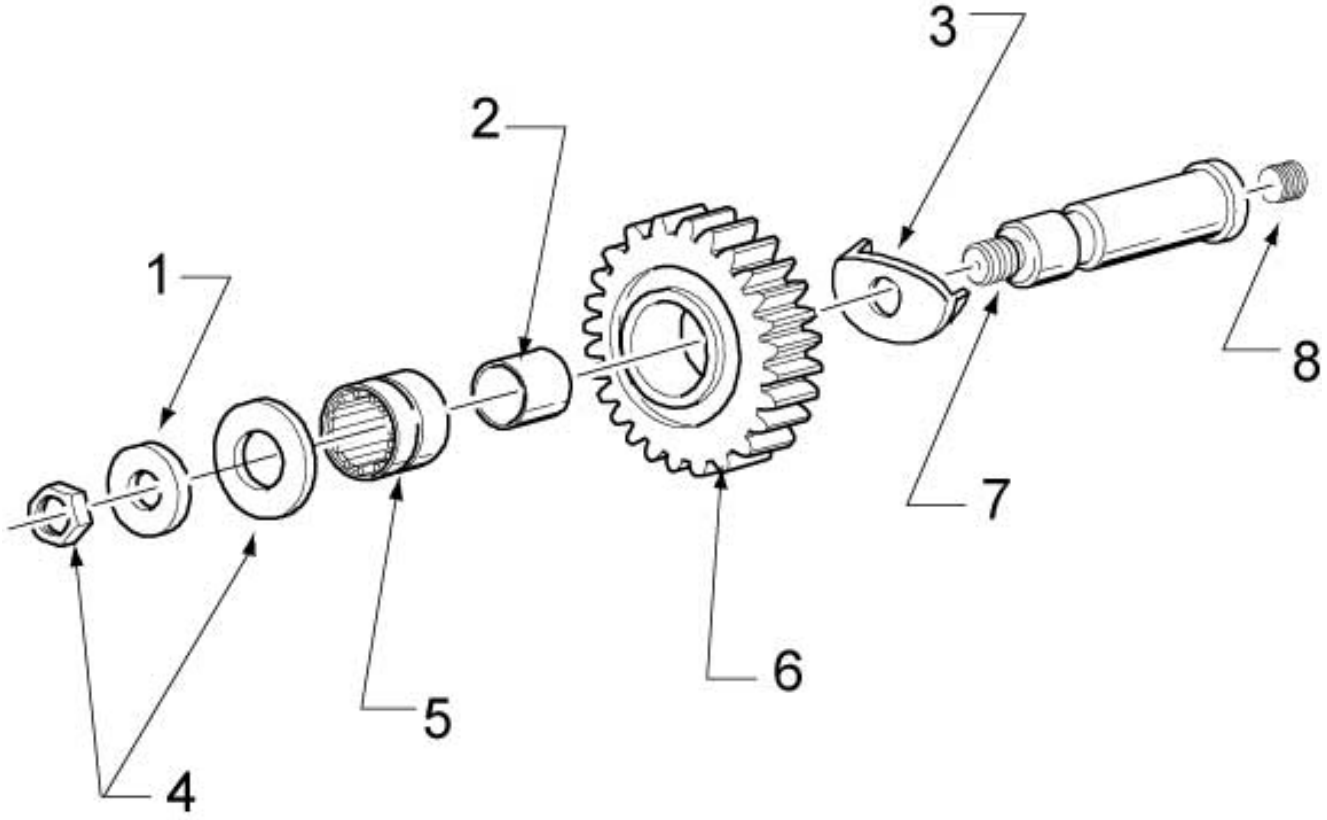
Special Instructions

In 1996 Eaton® changed the reverse idler system design. In the nut design, the reverse idler bearing was lubricated through a hole in the main case reverse idler support boss and a oil passage through the idler shaft middle.

Special Tools

- See Tool Information (see Table 6)
- Item T18: Bearing race installer

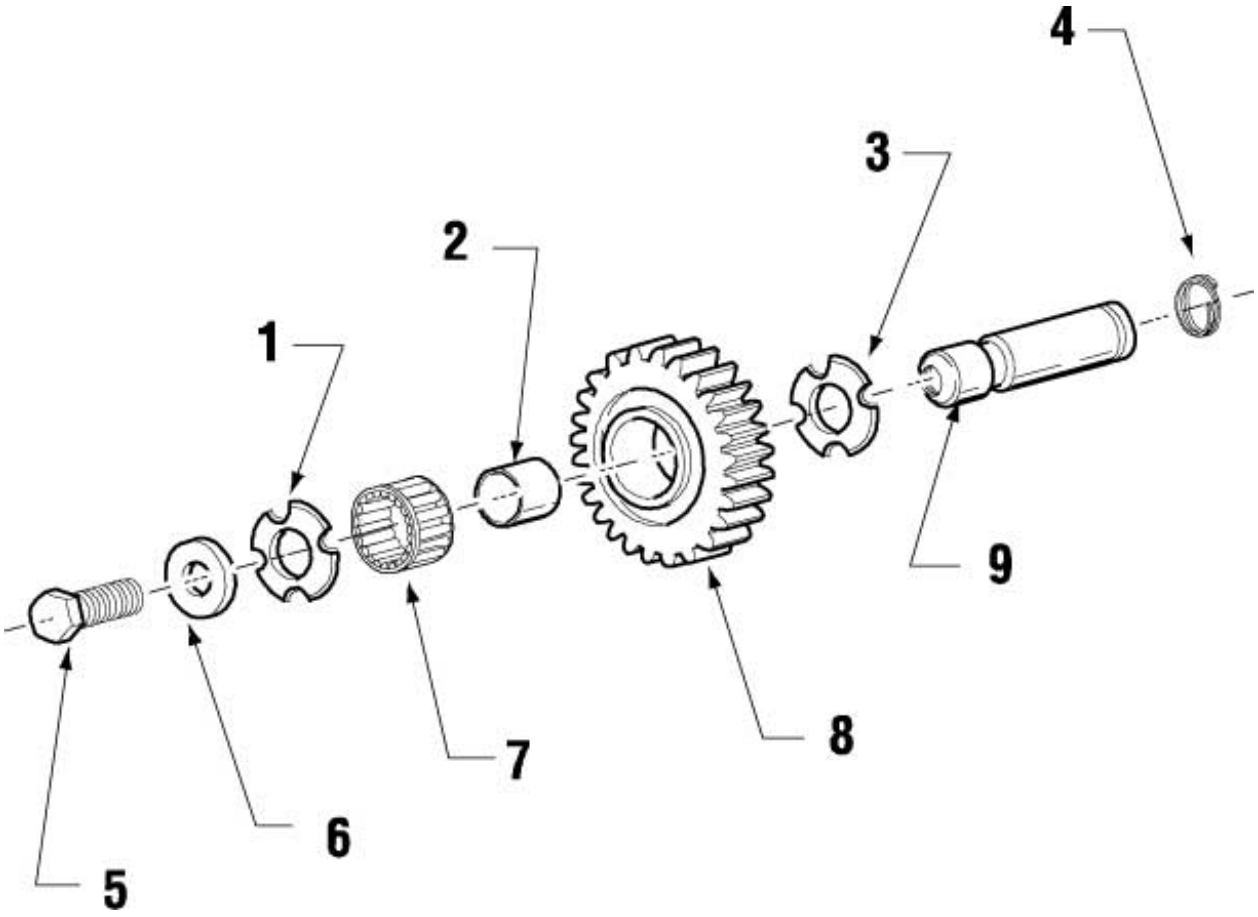
Previous Design



1. Idler Plate
2. Inner Race
3. Washer
4. Nut and Washer
5. Bearing
6. Reverse Idler Gear
7. Reverse Idler Shaft
8. Plug

The capscrew design eliminates the case hole and idler shaft hole. The reverse idler bearing is supplied oil through the use of star design thrust washers. If the nut design parts are used with the capscrew design, where main case does not have the oil feed hole, the reverse idler bearing will fail.

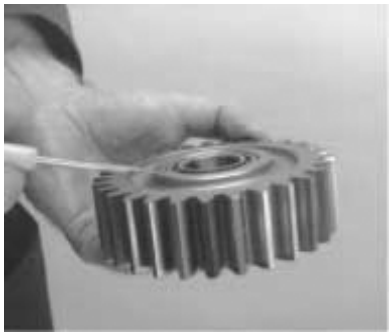
Current Design



1. Star Washer
2. Inner Race
3. Star Washer
4. Retaining Ring
5. Capscrew
6. Idler Plate
7. Bearing
8. Reverse Idler Gear
9. Reverse Idler Shaft

Procedure -

1. Position the reverse idler bearing and inner race into the reverse idler gear.



2. Position the gear in the case. The gear's long hub is positioned forward.

3. Place the rear thrust washer on the idler shaft.

4. From the case rear, insert the idler shaft through the main case bearing bore and into the reverse idler gear bearing.

5. As the idler shaft slides into the gear, insert the front thrust washer into position. Continue sliding the idler shaft into the case support boss.

6. From the rear, gently tap the idler shaft forward until resistance is felt.

7. Install the flat washer over the shaft threaded portion.

8. Apply Eaton® Fuller® Sealant #71205 or equivalent. Install capscrew and torque to 67-75 lb-ft (90.84-101.69 N•m).

9. Using a bearing race driver, install the auxiliary countershaft bearing race into the lower reverse idler bore.

   Note: The bearing races have a slip fit in their bores. They should slide or rotate easily into the case bore if they are not cocked.

How to Install Countershaft Assemblies

Special Instructions

Make sure the countershaft assemblies have been marked for proper position, 47- tooth PTO gear in the lower position.

Prior to installing the countershafts, the lower reverse idler gear assembly should be installed. In addition, if the transmission is equipped with an internal oil pump, this should also be installed.

Special Tools

- Toolmaker's dye

Procedure -

1. On the drive gear of each countershaft assembly, mark the tooth aligned with the gear keyway and stamped with an "O" for easy identification. A highly visible color of toolmaker's dye is recommended for making timing marks.

   Note: Prior to installing the countershafts, the lower reverse idler gear assembly should be installed. In addition, if the transmission is equipped with an internal oil pump, this should also be installed.

2. Place the lower, 47-tooth PTO gear countershaft, into the main case with the shaft seated in the lower countershaft case bores.

   Note: Use a large hook or piece of rope to support the countershaft if necessary.

3. Place the upper countershaft (with the 45 tooth PTO gear) into the main case with the shaft seated in the upper countershaft case bores.

How to Install the Lower Countershaft Bearings

Special Instructions

The lower reverse idler assembly should be installed before the lower countershaft.

The front bearing inner race must be pressed on the countershaft front.

The flanged-end driver must cover the bearing outer race for proper installation.

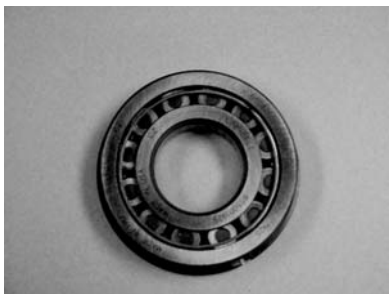
Special Tools

- See Tool Information (see Table 6)
- Item T7: Flanged-end bearing driver
- Item T8: Bearing driver
- Item T9: Countershaft support tool

Procedure -

1. Move the countershaft to the rear and insert the countershaft support tool to center shaft in rear case bore.

2. Obtain a spare inner countershaft race.



3. Temporarily install the spare countershaft inner race inside the front roller bearing for installation.

4. Use a flanged-end driver to start the front bearing in case bore.

5. Use a screwdriver inserted in the countershaft capscrew bore to help center the countershaft.

6. Move the countershaft forward into the bearing.

7. Use a flanged-end bearing driver and maul to completely seat the front bearing in the case bore.

   Note: Make sure to contact only the bearing and not the temporary race with the driver. The temporary race should fall out when installation is complete.

8. On the countershaft front, position the retainer plate with roll pin in hole at shaft end.

9. Install the front bearing retainer plate and capscrew. If the capscrew is being reused, apply Eaton® Fuller® thread sealant #71205 or equivalent. Torque the capscrew to 90-120 lb-ft (122.02-162.70 N•m).

   Note: Earlier models may have a roll pin in the retainer. This roll pin is not required and was removed on units built after 1994.

10. From the rear, remove the countershaft support tool.

11. Install the rear countershaft bearing. Position the bearing so that the larger chamfer on the bearing inside diameter is installed towards the shaft. Use a bearing driver that contacts both the bearing inner race and outer race.

12. In the countershaft rear groove, install the rear snap ring.

    Note: Make sure the front bearing capscrew is properly torqued.

    Note: Make sure the rear snap ring is in place.

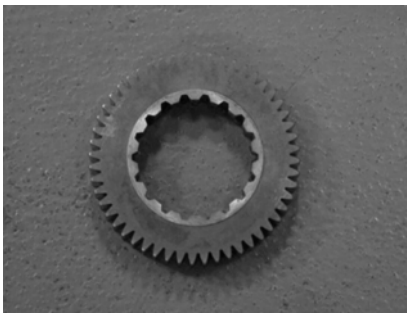
How to Install the Input Shaft and Main Drive Gear

Special Instructions

None

Special Tools

- See Tool Information (see Table 6)
- Item T10: Input bearing driver
- Toolmaker's dye



Procedure -

1. Use a highly visible toolmaker's dye and mark the main drive gear for timing purposes. To mark the gear, paint toolmaker's die on any two adjacent teeth, and then paint the two adjacent teeth directly opposite the first two teeth.

2. If necessary, install the bushing in the back of the input shaft.

3. Temporarily position the upper countershaft up and away from the transmission center.

4. From inside the case, mesh the lower countershaft drive gear marked tooth with either set of main drive gear marked teeth.

5. From the front, engage the input shaft spline teeth into the main drive gear.

   Note: The current design input shaft spline teeth have noticeable clearance to the main drive gear internal spline teeth. This is normal.

6. Install the snap ring in the main drive gear inside groove.

7. Install the spacer washer over the input shaft. With the bearing external snap ring to the outside, position the bearing on the input shaft.

8. Install the input shaft bearing over the input shaft. Use a flanged-end bearing driver which contacts both the bearing inner race and outer race. Drive the bearing until it contacts the front case.

9. Temporarily install the front bearing cover with two capscrews.

10. From inside the main case, drive the input shaft forward until it is fully seated.

11. Install the input shaft retaining snap ring.

    Note: Do not replace the small rubber lip seal. It is used only to prevent leakage during shipping.

12. Do not reinstall the input bearing cover at this time. Instead, pull the input shaft and bearing forward to allow for mainshaft installation.

How to Install the Mainshaft Assembly

Special Instructions

The lower countershaft bearings and the input shaft must be installed, but for higher torque ratings do not install the front bearing cover.

Check to make sure the lower countershaft drive gear marked tooth is in time with main drive gear set of marked teeth.

Special Tools

- A large hook or 3' piece of rope

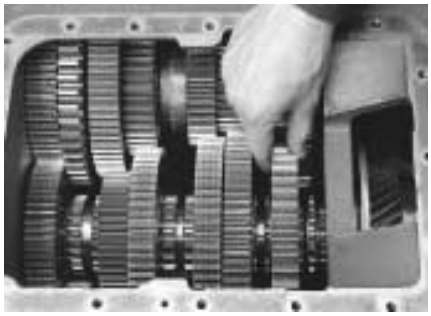
Procedure -

1. Block the upper countershaft forward and as close to the case wall as possible.

2. With reverse gear forward against the next speed gear and mainshaft pilot end over the integral oil pump gear, lower the mainshaft assembly while pulling the shaft rear through the case bore.

3. Pull the input shaft forward until the drive gear is against the case.

4. After the mainshaft drops into the case, slide the countershaft back and the mainshaft should fall down between the countershafts.



5. Move the mainshaft pilot-end into the input shaft pilot bushing. Mesh the mainshaft gears with the corresponding countershaft assembly gears.

6. Position the upper reverse idler gear in case.

   Note: At this time other components of the front section must be installed before the mainshaft installation can be completed, see the procedure "How to Install the Upper Countershaft Bearings".

7. Mesh the reverse gear teeth with the reverse idler gear teeth and move the reverse gear to the rear as far as possible.

8. Align the reverse gear spacer external splines with the reverse gear and move the spacer into the reverse gear.

9. Install the reverse gear I.D. snap ring and move the reverse gear forward on the mainshaft and against the reverse gear limit washer.

10. Push the input shaft bearing back into the case bore.

11. Position a new gasket on the bearing cover mounting surface, make sure to align the gasket oil return hole with case oil return hole.

12. Position the front bearing cover, make sure to align the cover oil return hole with case oil return hole.

13. Secure the front bearing cover with six (6) capscrews, torque to 35–45 lb-ft (47.45-61.01 N•m).

    Note: Make sure the drive gear is timed with the both countershafts.

    Note: Make sure the front bearing cover capscrews are tighten properly.

How to Install the Upper Countershaft Bearings

Special Instructions

The front bearing inner race must be pressed on the countershaft front.

The flanged-end driver must cover the bearing outer race for proper installation.

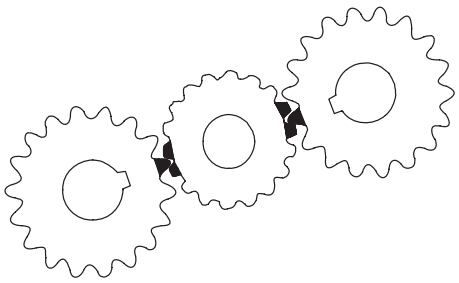
Temporarily use the assembled auxiliary drive gear to hold the mainshaft in the input shaft pilot.

CAUTION: The upper countershaft bearings must be installed after the installation of the mainshaft.

Special Tools

- See Tool Information (see Table 6)
- Item T7: Flanged-end bearing driver
- Item T8: Bearing driver
- Item T9: Countershaft support tool

Figure 3



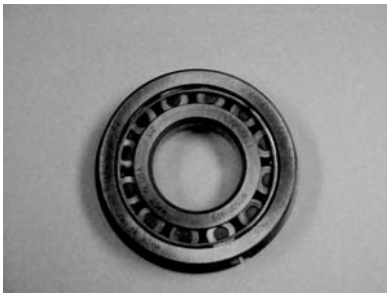
Procedure -

1. Make sure the lower countershaft and main drive gear timing marks are aligned.
2. Mesh the upper countershaft marked tooth with the two remaining main drive gear marked teeth.

3. Move the countershaft to the rear and insert the countershaft support tool to center shaft in rear case bore.

4. Obtain a spare inner countershaft race.

5. Temporarily install a spare countershaft inner race inside the front roller bearing for installation.



6. Use a flanged-end driver to start the front bearing in case bore.

7. Use a screwdriver inserted in the countershaft capscrew bore to help center the countershaft.

8. Move the countershaft forward into the bearing.

9. Use a flanged-end bearing driver and maul to completely seat the front bearing in the case bore.

   Note: Make sure to contact only the bearing and not the temporary race with the driver. The temporary race should fall out when installation is complete.

10. On the countershaft front, position the retainer plate with roll pin in hole at shaft end.

11. Install the front bearing retainer plate and capscrew. If the capscrew is being reused, apply Eaton® Fuller® thread sealant #71205 or equivalent. Torque the capscrew to 90-120 lb-ft (122.02-162.70 N•m).

    Note: Earlier models may have a roll pin in the retainer. This roll pin is not required and was removed on units built after 1994.

12. From the rear, remove the countershaft support tool.

13. Install the rear countershaft bearing. Position the bearing so that the larger chamfer on the bearing inside diameter is installed towards the shaft. Use a bearing driver that contacts both the bearing inner race and outer race.

14. In the countershaft rear groove, install the rear snap ring.

    Note: Make sure the front bearing capscrew is properly torqued.

    Note: Make sure the rear snap ring is in place.

How to Assemble the Upper Reverse Idler Gear Assembly

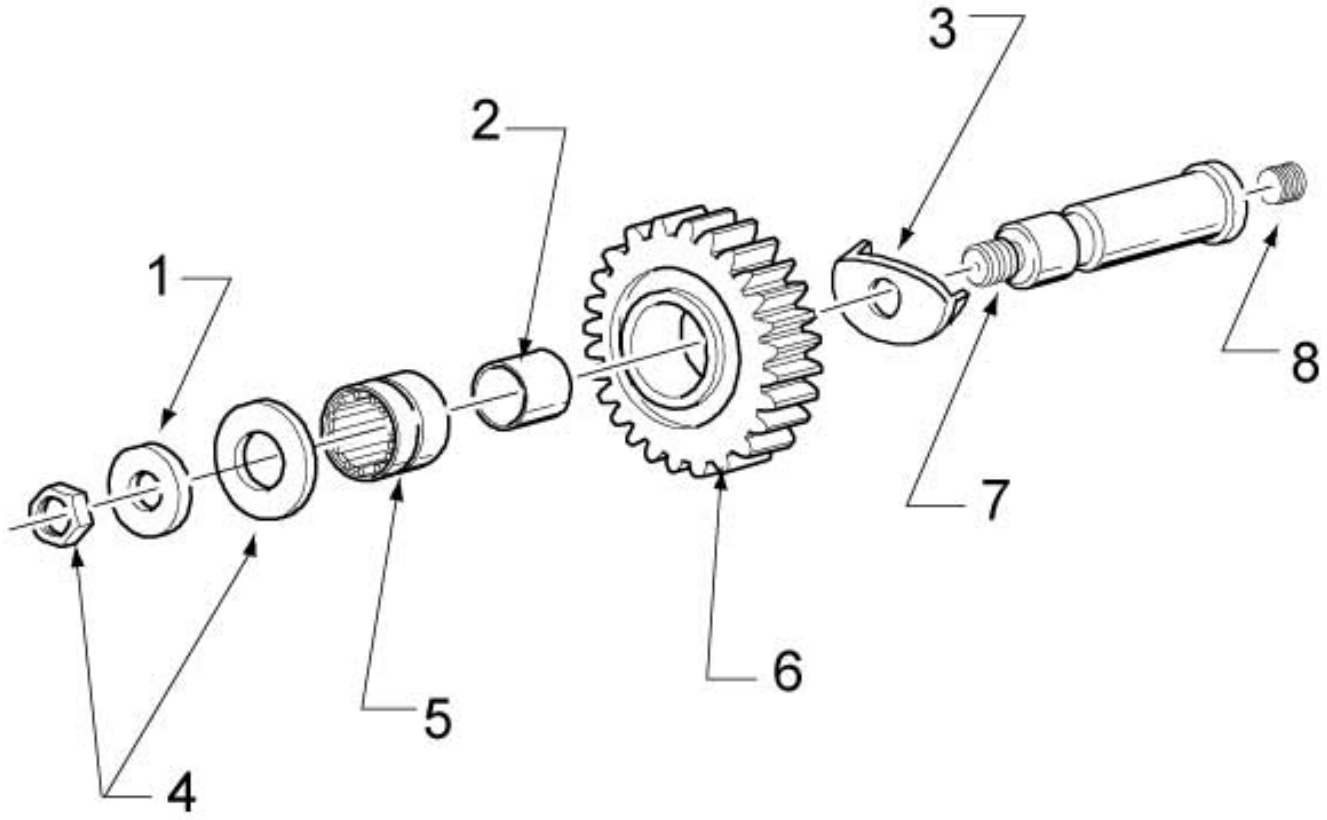
Special Instructions

In 1996 Eaton® changed the reverse idler system design. In the nut design, the reverse idler bearing was lubricated through a hole in the main case reverse idler support boss and a oil passage through the idler shaft middle.

Special Tools

- See Tool Information (see Table 6)
- Item T18: Bearing race installer

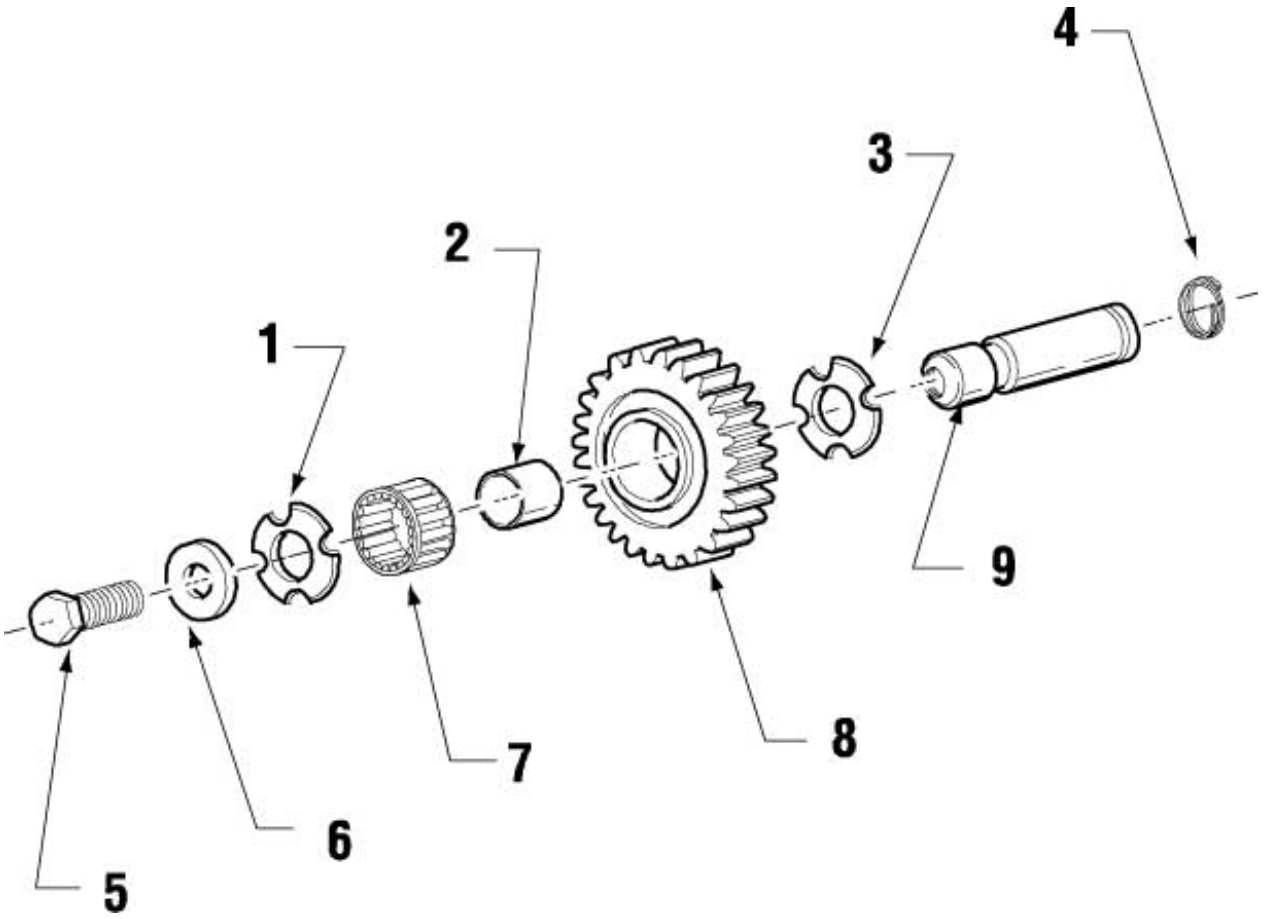
Previous Design



1. Idler Plate
2. Inner Race
3. Washer
4. Nut and Washer
5. Bearing
6. Reverse Idler Gear
7. Reverse Idler Shaft
8. Plug

The capscrew design eliminates the case hole and idler shaft hole. The reverse idler bearing is supplied oil through the use of star design thrust washers. If the nut design parts are used with the capscrew design main case which does not have the oil feed hole, the reverse idler bearing will fail.

Current Design



1. Star Washer
2. Inner Race
3. Star Washer
4. Retaining Ring
5. Capscrew
6. Idler Plate
7. Bearing
8. Reverse Idler Gear
9. Reverse Idler Shaft

Procedure -

1. Place the rear thrust washer on the idler shaft.

2. From the rear, insert the idler shaft through the main case bearing bore and into the reverse idler gear bearing.

3. As the idler shaft slides into the gear, insert the front thrust washer into position. Continue sliding the idler shaft into the case support boss.

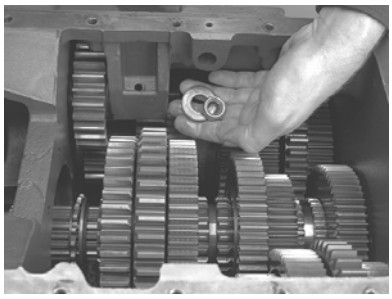
4. From the rear, gently tap the idler shaft forward until resistance is felt.

5. Install the flat washer over the shaft threaded portion.

6. Inspect the reverse idler nut nylon locking material. Replace the capscrew, if necessary. Install the capscrew and torque to 67-75 lb-ft (90.84-101.69 N•m).

7. Using a bearing race driver, install the auxiliary countershaft bearing race into the lower reverse idler bore.

   Note: The bearing races have a slip fit in their bores. They should slide or rotate easily into the case bore if they are not cocked.



How to Install the Auxiliary Drive Gear Assembly

Special Instructions

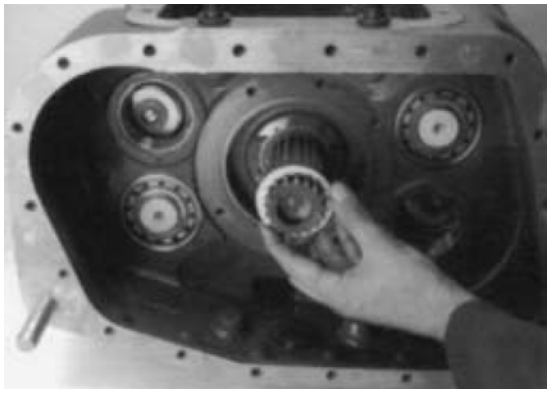
Before removing the auxiliary drive gear, the auxiliary section must be removed.

Special Tools

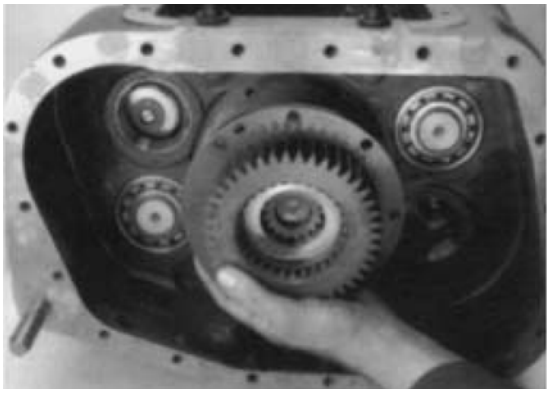
- Large pair of snap ring pliers

Procedure -

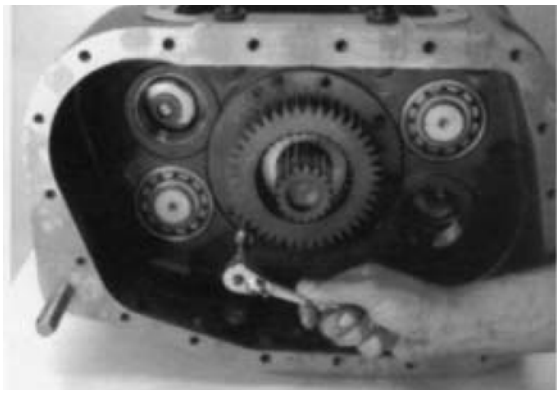
1. Install the snap ring and splined washer on the mainshaft.

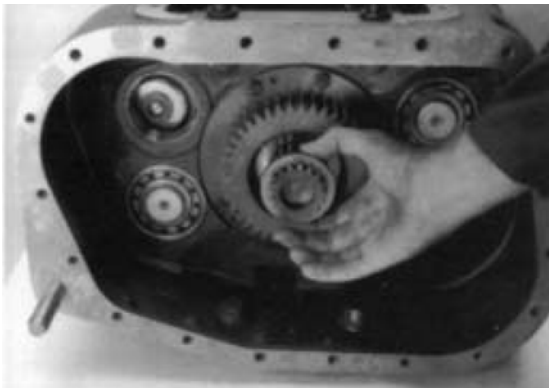


2. Reinstall the front auxiliary drive gear assembly on rear of mainshaft. Use a flanged-end driver and maul to set bearing in case bore.

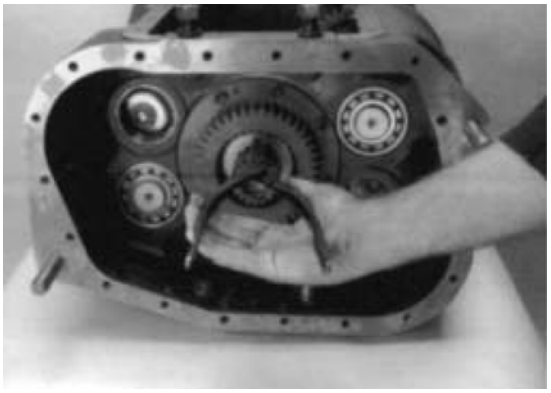


3. Align the six capscrew holes in retainer with the tapped holes in case and install capscrews. Tighten to recommended torque ratings and lockwire the capscrews in groups of three.





4. Install splined washer on mainshaft splines behind auxiliary drive gear.



5. Install the snap ring in groove at end of mainshaft.

How to Install the Clutch Housing

Special Instructions

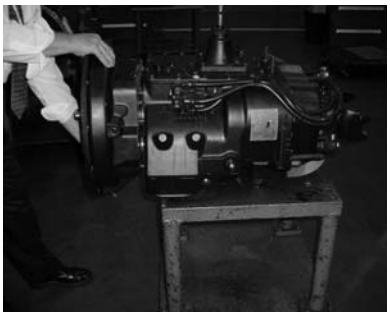
Installation of the clutch housing is done in the horizontal position.

Special Tools

- Typical service tools

Procedure -

1. Position a new gasket on the housing mounting surface with beads toward case.



2. Install the clutch housing on the front box, pilot it on the six studs and drive gear bearing cover.
3. Install the nuts with washers or lock washers on the studs, tighten to 180–190 Lb•ft of torque.
4. Install the capscrews with lock washers, tighten to 90–100 Lb•ft of torque.

   Note: Make sure the capscrews are properly torqued.

How to Disassemble the Integral Oil Pump without Auxiliary Oil Tube

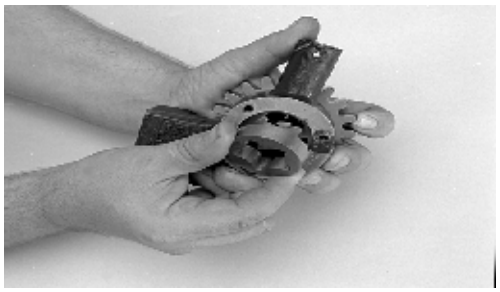
Special Instructions

None

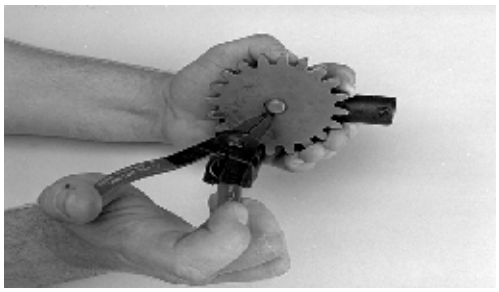
Special Tools

- Typical service tools
- A vise with brass jaws or wood blocks

Procedure -



1. From the assembly, remove the outer oil pump element.

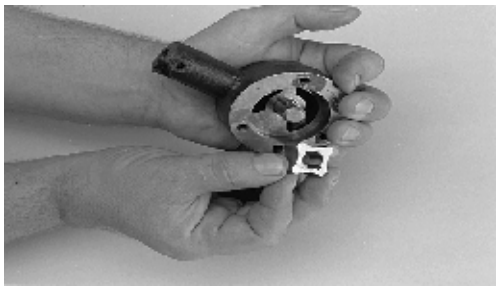


2. From the drive shaft, remove the drive gear retaining snap ring.
3. From the pump drive shaft, remove the drive gear.

4. From the drive shaft keyway, remove the key.

5. From the drive shaft, remove the element snap ring.

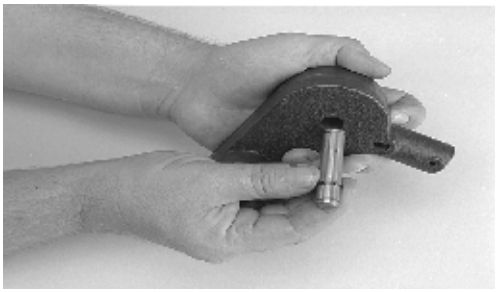
6. From the drive shaft, remove the internal oil pump element.

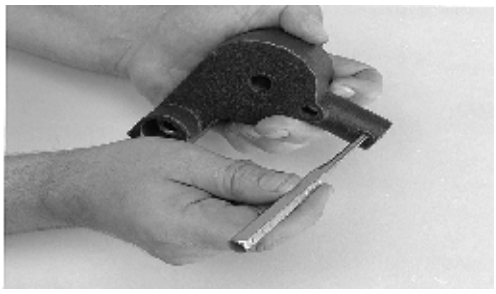


7. From the drive shaft keyways, remove the two (2) keys.

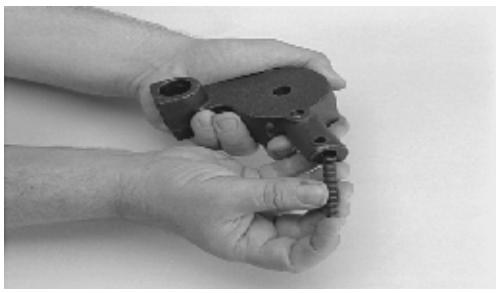
8. From the integral oil pump housing, remove the drive shaft.

9. If damaged, from the drive shaft, remove the rear drive gear retention snap ring.

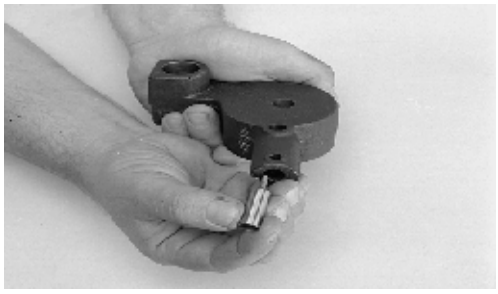




10. From the pump housing, remove the relief valve roll pin.



11. From the relief valve housing bore, remove the relief valve spring.



12. From the housing bore, remove the relief valve.
13. Inspect all parts for damage, replace damaged parts.

How to Assemble the Integral Oil Pump without Auxiliary Oil Tube

Special Instructions

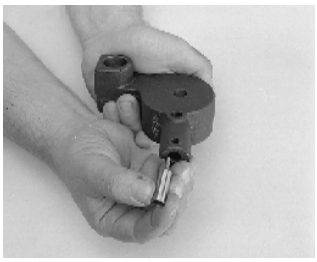
When installing the drive shaft keys, the round key goes in the round keyway and the square key in the square keyway.

Special Tools

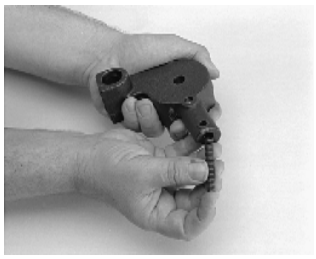
- A vise with brass jaws or wood blocks

Procedure -

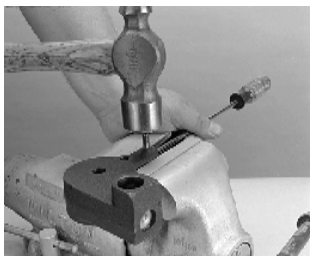
1. Install the relief valve in the integral oil pump housing.

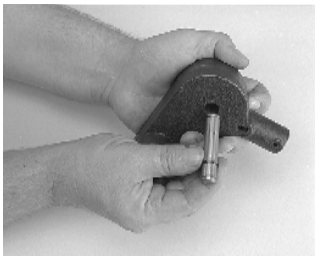


2. Install the relief valve spring in oil pump housing.



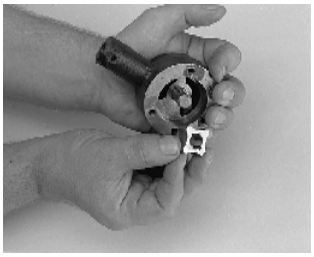
3. Secure the oil pump housing in a vice.
4. Depress the relief valve spring and drive the relief valve retention roll pin into the roll pin bore.



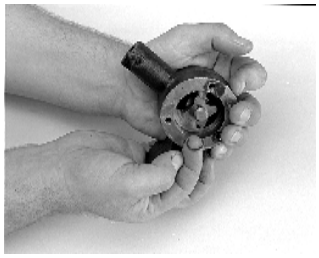


5. If removed, replace the drive shaft snap ring on the pump drive shaft.
6. Insert the drive shaft through the pump housing bore.

7. Install the two (2) keys on the drive shaft.

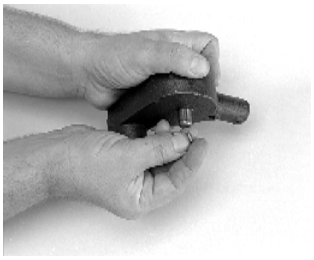


8. Align the inner element keyways with the drive shaft keys and install the integral oil pump inner element.



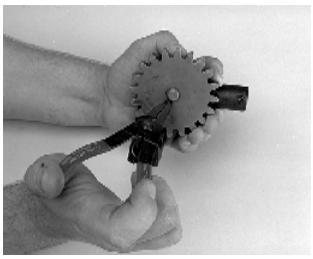
9. Install the inner element retention snap ring in drive shaft snap ring groove.

10. Install drive gear key in drive shaft keyway.

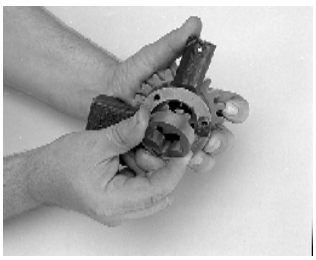


11. Align drive gear keyway with drive shaft key and install the drive gear on the drive shaft.

12. Install the outer drive gear retention snap ring in drive shaft groove.



13. Install the outer integral oil pump element over the inner element.



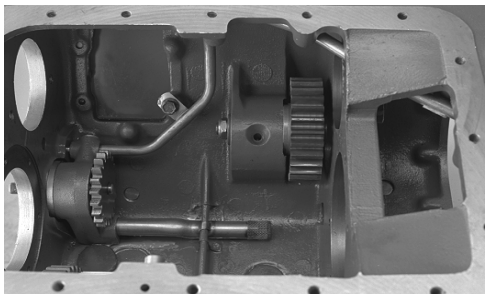
How to Remove the Integral Oil Pump

Special Instructions

None

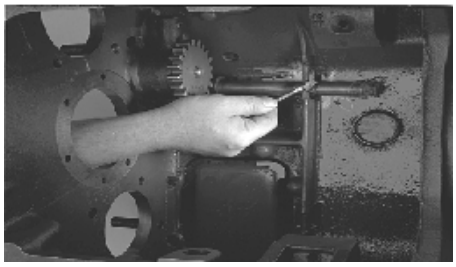
Special Tools

- Typical service tools

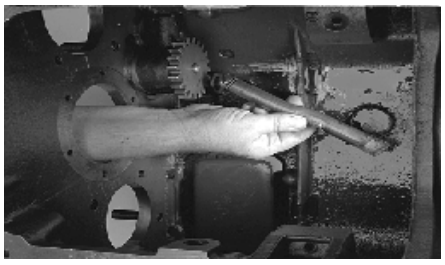


Procedure -

1. Remove the capscrews holding the suction and auxiliary oil tubes in position.

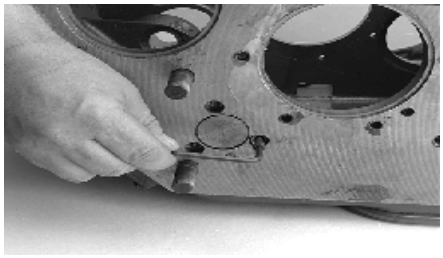


2. Straighten tube lock on suction tube.

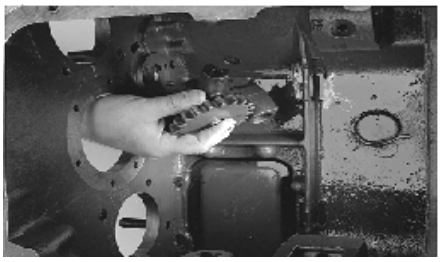


3. Remove suction tube from oil pump. If necessary, remove o-ring from suction tube.

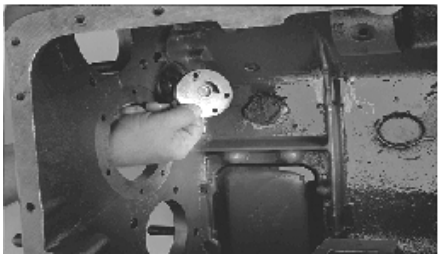
4. Remove three (3) allen head capscrews and washers that retain the integral oil pump to the case.



5. Remove the integral oil pump assembly from inside the case.



6. Remove the integral oil pump retainer plate from inside the case.



7. If necessary, the front case plug can be removed from the case. To remove, insert a bar from inside the case and tap the plug out.

8. Inspect the plug o-ring for cracks and pitting. Replace if damaged.

How to Install the Integral Oil Pump

Special Instructions

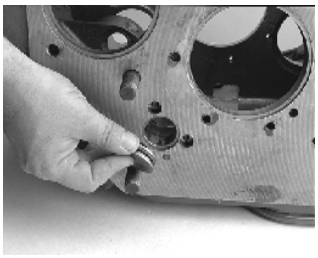
Lubricate the case front plug o-ring with Eaton® Fuller® lubricant #71206 or equivalent.

Special Tools

- Typical service tools

Procedure -

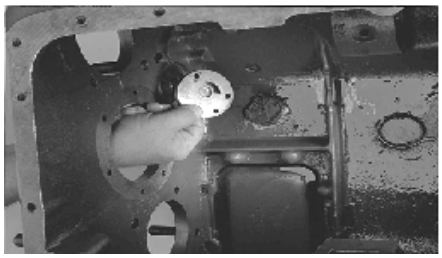
1. If removed, replace the front case pump plug o-ring. lubricate the grove of the plug, install the o-ring onto the plug, and then lubricate the outer diameter of the o-ring.



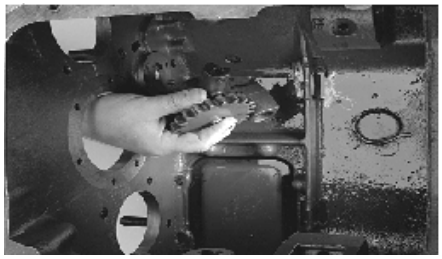
2. Seat the front case pump plug in the case bore by hand. Do not install the pump plug using any type of impact tool (i.e. hammer, maul, etc.).

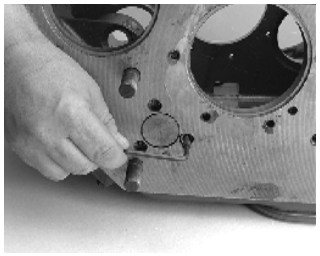
   Note: P/N 4303107 retainer plate, which has a smaller outside diameter, must be used with maincase machined after April 1995. If an older oil pump assembly is installed into a new case, P/N 20510 retainer plate will not seat properly in the spot face machined in the case wall

3. With the retainer bore facing the case rear, install the integral oil pump over the alignment pin inside the case.



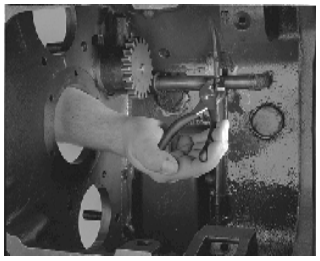
4. Align oil pump with retainer and alignment pin and install the integral oil pump assembly.





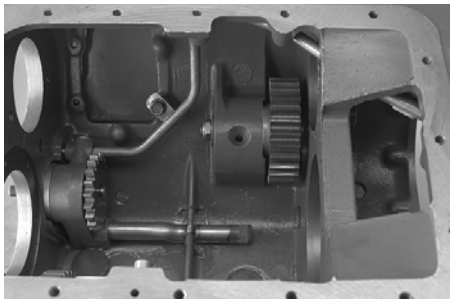
5. Install three (3) allen head capscrews and washers through the case front and into the pump housing. Torque the capscrews to 8-12 lb-ft (10.85-16.30 N•m).

6. Replace the o-ring on the suction tube.



7. Install the tube under the case rib and into the integral oil pump.

8. Bend the suction tube lock over the case rib.



9. Position the oil tube in the case bottom through the intermediate wall.

10. Apply Loctite 242 to capscrew threads. Torque capscrews to 35-45 lb-ft (47.45-61.01 N•m).

    Note: Make sure the integral oil pump drive gear can turn.

How to Disassemble the Integral Oil Pump with Auxiliary Oil Tube

Special Instructions

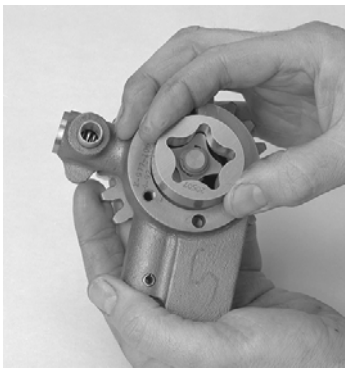
None

Special Tools

- A vise with brass jaws or wood blocks

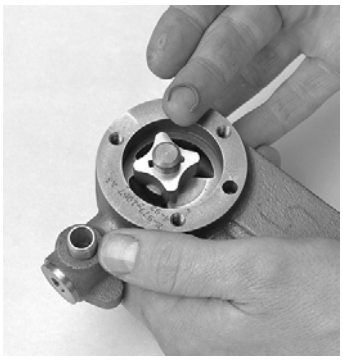
Procedure -

1. From the assembly, remove the outer oil pump element.

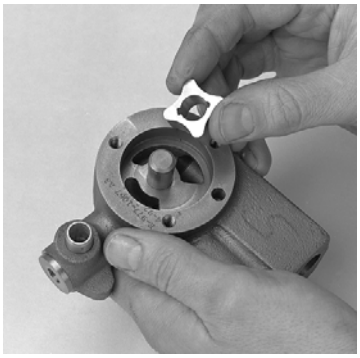


2. From the drive shaft, remove the drive gear retaining snap ring.
3. From the pump drive shaft, remove the drive gear.

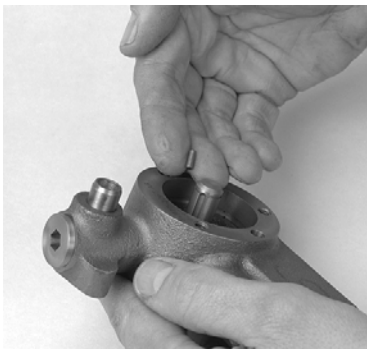
4. From the drive shaft keyway, remove the key.



5. From the drive shaft, remove the element snap ring.



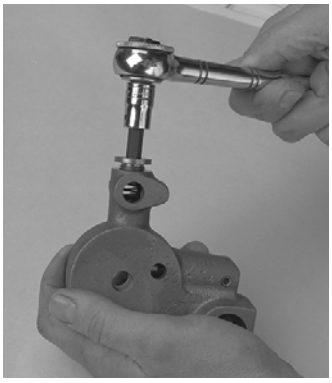
6. From the drive shaft, remove the internal oil pump element.



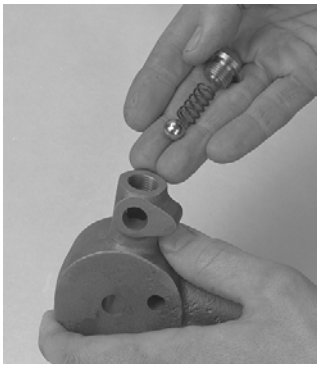
7. From the drive shaft keyways, remove the two (2) keys.
8. Remove the transfer tube.

9. From the integral oil pump housing, remove the drive shaft.
10. If damaged, from the drive shaft, remove the rear drive gear retention snap ring.

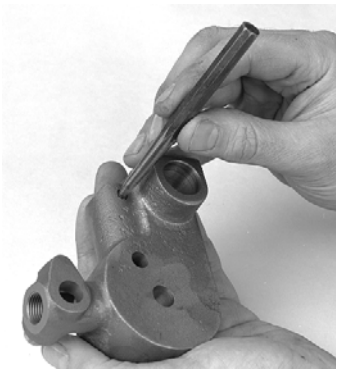
11. Loosen the retaining nut.



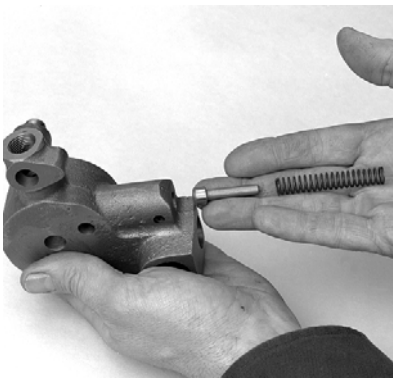
12. Remove the retaining nut, spring and ball.



13. From the pump housing, remove the relief valve roll pin.



14. From the relief valve housing bore, remove the relief spring and relief valve.



15. Remove the valve cover.
16. Inspect all parts for damage, replace damaged parts.

How to Assemble the Integral Oil Pump with Auxiliary Oil Tube

Special Instructions

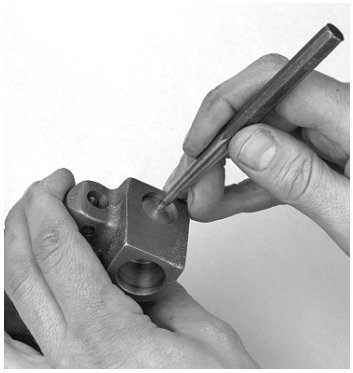
When installing the drive shaft keys, the round key goes in the round keyway and the square key in the square keyway.

Special Tools

- A vise with brass jaws or wood blocks

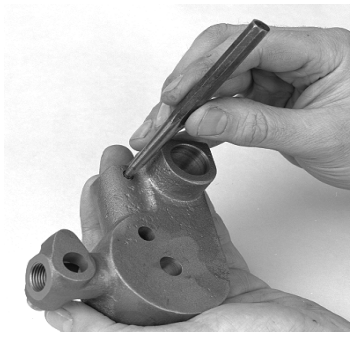
Procedure -

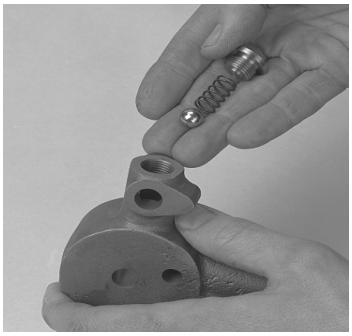
1. Install the valve cover.



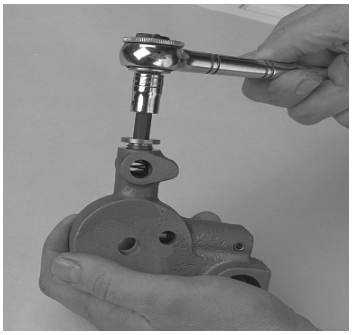
2. Install the relief valve and relief valve spring in the integral oil pump housing.
3. Secure the oil pump housing in a vice.

4. Depress the relief valve spring and drive the relief valve retention roll pin into the roll pin bore.

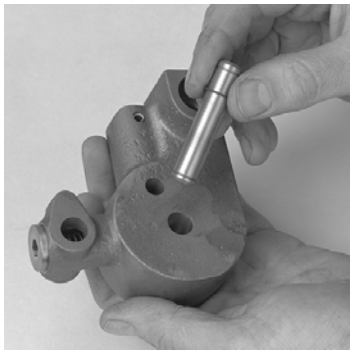




5. Install the ball, spring and retaining nut.



6. Torque the retaining nut to 40-45 lb-ft (54.23-61.01 N•m).
7. If removed, replace the drive shaft snap ring on the pump drive shaft.

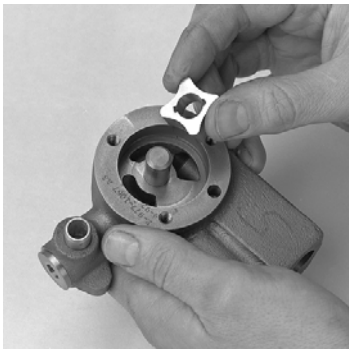


8. Insert the drive shaft through the pump housing bore.

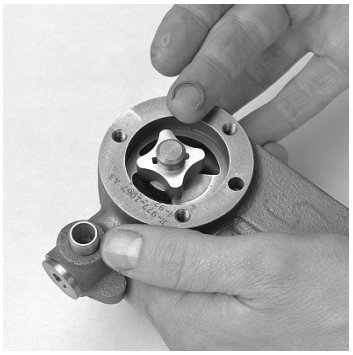
9. Install the two (2) keys on the drive shaft.

10. Install the transfer tube.

11. Align the inner element keyways with the drive shaft keys and install the integral oil pump inner element.



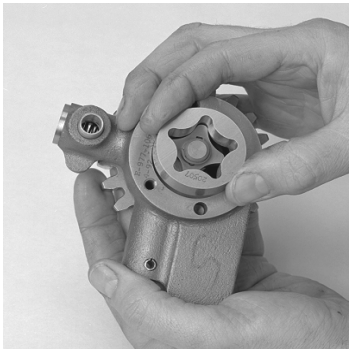
12. Install the inner element retention snap ring in drive shaft snap ring groove.



13. Install drive gear key in drive shaft keyway.

14. Align drive gear keyway with drive shaft key and install the drive gear on the drive shaft.

15. Install the outer drive gear retention snap ring in drive shaft groove.



16. Install the outer integral oil pump element over the inner element.

How to Install the Auxiliary Section with Tapered Bearings

Special Instructions

There are different capscrew lengths, install in the correct location.

Auxiliary sections can be installed either with the transmission in the horizontal position or the vertical position.

To install in the vertical position, the clutch housing must be installed.

Special Tools

- See Tool Information (see Table 6)
- Item T2: Auxiliary section hanger bracket for horizontal removal
- A steel bar longer than the width of the output yoke for vertical removal
- A hoist with a lifting chain

Procedure -

1. **To install the auxiliary section in the horizontal position:** Position a new gasket on the transmission mounting surface.
2. Attach an auxiliary section hanger bracket to the auxiliary section top.
3. Attach a lifting chain to the auxiliary section hanger bracket.
4. Position the auxiliary section on the two (2) dowel pins.
5. Slide the auxiliary section on until the hanger bracket contacts the front section back.
6. Remove the auxiliary section hanger bracket.
7. Slide the auxiliary section the rest of the way into position.

8. Apply Eaton® Fuller® Sealant #71205 or equivalent to the retaining capscrews.
9. Install the retaining capscrews, torque to 35-45 lb-ft (47.45-61.01 N•m).
10. To finish installation, see "The Shimming Procedure for Tapered Bearings".

Procedure -

1. **To install the auxiliary section in the vertical position:** With blocks under the clutch housing to prevent input shaft damage, place the transmission in the vertical position, clutch housing down.
2. Position a new gasket on the transmission mounting surface.
3. Install a steel bar through the yoke.
4. Attach a lifting chain to the steel bar.
5. Position the auxiliary section over the two (2) dowel pins.
6. Slide the auxiliary section down the dowels.

7. Apply Eaton® Fuller® Sealant #71205 or equivalent to the retaining capscrews.
8. Install the retaining capscrews, torque to 35-45 lb-ft (47.45-61.01 N•m).
9. Remove the steel bar and chain.
10. To finish installation, see "The Shimming Procedure for Tapered Bearings".

    Note: Make sure the input shaft rotates.

Shim Procedure without a Shim Tool for Tapered Bearings

Special Instructions

The shim procedure can be done in the horizontal or vertical position. The procedure is done the same.

⚠ CAUTION

Use genuine Eaton® replacement gaskets for the auxiliary housing and countershaft bearing cover. Do not omit the gaskets. Bearing endplay is influenced by the compressed thickness of the gasket (0.011-0.012" or 0.28-0.30 mm).

The bearing endplay must be checked and adjusted any time a countershaft, bearing, or housing is replaced. If, during reassembly, the same countershaft, bearings, housing, and shims are reused and kept in the same location, it is not necessary to reset bearing endplay.

The following procedure is used to adjust the endplay for the auxiliary countershaft tapered bearings. By correctly following this procedure, each countershaft will have 0.001"-0.005" (0.03-0.12 mm) endplay.

Shims must be aligned properly or else the rear bearing cover may be damaged when final torque is applied.

Special Tools

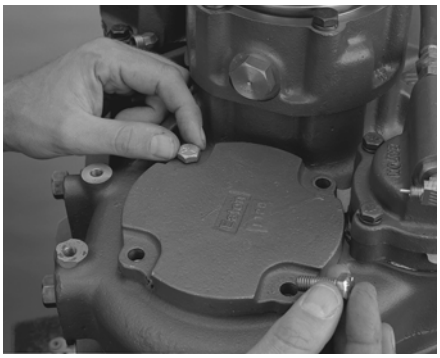
- Typical service tools
- Shims and Feeler gauge

Procedure -

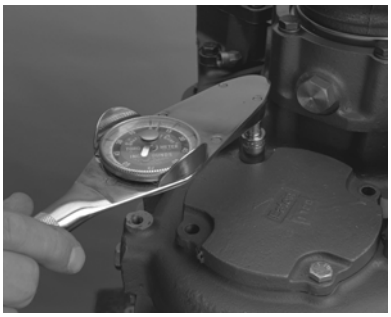
1. The auxiliary countershaft bearing covers or countershaft straps and shims should be removed. Make sure all old gasket material is cleaned from the gasket mounting surfaces on the countershaft bearing covers and the auxiliary housing.

2. Verify that the auxiliary section is in gear. When the output shaft is rotated, the countershafts must also rotate. If not shift the auxiliary into gear by applying shop air to the high range air port on range cylinder to shift into gear.

3. Make sure a 0.100 countershaft rear bearing shim is installed. Be sure the countershaft rear bearing races are seated in the bearing bores.



4. Install two (2) clean 3/8 " x 1" capscrews without washers directly across from each other in each bearing cover. Tapped

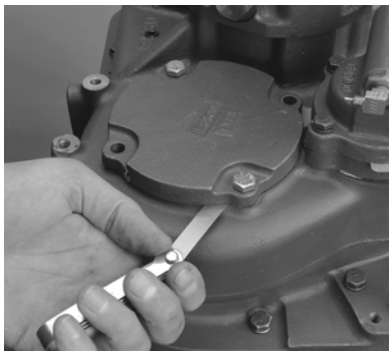


holes in auxiliary case must be free of thread adhesive.

5. Evenly torque the capscrews to 7 lb-in (0.79 N•m) . Do not install the countershaft rear bearing cover gasket. The gap between the bearing cover and the housing surface should be even from side to side.

   Note: 7 lb-in (0.79 N•m) is slightly more than finger tight. Do not overtighten the capscrews. If the capscrews are too tight, the bearing cover will become distorted.

6. Rotate the output shaft 4 times clockwise and 4 times counterclockwise. The rotation will seat and align the rollers in each tapered bearing. Re-torque the capscrews to 7 lb-in (0.79 N•m). If the countershafts do not rotate, the range sliding clutch or deep reduction sliding clutch is in neutral. Apply shop compressed air to shift cylinders to shift the sliding clutches into gear.



7. Use a feeler gauge, as close to each capscrew location as possible, and measure the gap between the countershaft rear bearing cover and the auxiliary housing gasket surface. Measure and record the gap at both capscrew locations.

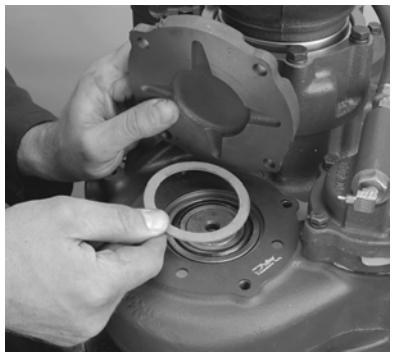
8. Average the two feeler gauge measurements by adding the measurements together and dividing by 2 as shown in Example.

Shim Chart

Gap 1 = 0.060 ; Gap 2 = 0.050
Total Gap = 0.060 + 0.050 = 0.110
Average = 110/2 = 0.055
Select yellow shim as indicated in the shim chart at the end of this selection.

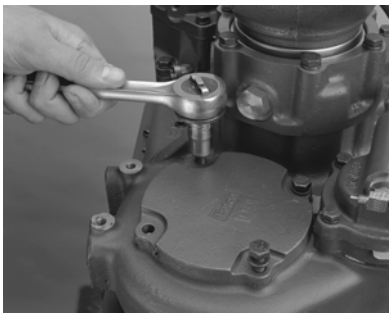
9. Locate the feeler gauge average measurement in the shim chart to determine the required shim and color code.

Note: The oil pump shim is used when an auxiliary oil pump or PTO is mounted on the countershaft. The oil pump shims have a smaller outside diameter.



10. Remove the countershaft rear bearing cover and gauging shim.

11. Place the selected shim on the rear countershaft bearing race.



12. Position a new gasket on countershaft rear bearing cover mounting surface.

13. Position the countershaft rear bearing cover over the new gasket.

14. Apply Eaton® Fuller® thread sealant #71205 or equivalent to the auxiliary countershaft rear bearing cover capscrews and auxiliary countershaft rear bearing cover.

15. Install the auxiliary countershaft rear bearing cover and secure it with the capscrews. Make sure the shim is in the proper location and is not pinched between the cover and the housing. Torque the capscrews to 40-45 lb-ft (54.23-61.01 N•m).

    Note: Use a thick grease to hold the shim in position when installing the cover.

16. Repeat this procedure for the remaining countershaft.

    Note: Make sure the input shaft rotates.

Shim Table

FEELER GAUGE AVERAGE GAP	SHIM THICKNESS	STANDARD SHIM PART NUMBER	OIL PUMP SHIM PART NUMBER	COLOR CODE
0.072-0.075	0.033-0.034	4302345	4302346	Gold
0.69-0.0715	0.036-0.037	21452	21472	Red
0.066-0.0685	0.039-0.040	21453	21473	Pink
0.063-0.0655	0.042-0.043	21454	21474	Brown
0.060-0.0625	0.045-0.046	21455	21475	Tan

Shim Table (Continued)

FEELER GAUGE AVERAGE GAP	SHIM THICKNESS	STANDARD SHIM PART NUMBER	OIL PUMP SHIM PART NUMBER	COLOR CODE
0.057-0.0595	0.048-0.049	21456	21476	Orange
0.054-0.0565	0.051-0.052	21457	21477	Yellow
0.051-0.0535	0.054-0.055	21458	21478	Green
0.048-0.0505	0.057-0.058	21459	21479	Light Blue
0.045-0.0475	0.060-0.061	21460	21480	Lavender
0.042-0.0445	0.063-0.064	21461	21481	White
0.039-0.0415	0.066-0.067	21684	21686	Black
0.036-0.0385	0.069-0.070	21685	21687	Silver

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